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THE AMERICAN POTASH INSTITUTE
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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington, D. C.

VOLUME XXVI NUMBER 4

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FLAX—ANOTHER CROP WHICH THE WAR HAS BROUGHT INTO INCREASED ATTENTION.

Better Crops with PLANT FOOD

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For farmers Nature has..

Secrets Galore

Jeff McDermid

FROM our mutual friend, Jonathan Turnipseed, I gleaned a text for an April piece. In remarking to me lately about a chat with the stockyards weighmaster, this farmer friend described the colloquy as follows:

"It's gettin' to a pretty pass when the whole Nation goes in fer secrecy," says the stockyards man when I unloaded my steers yesterday. "As fer me, I can't be secret about anything, not even my income, which is so small you can't hardly see it after I pay my taxes. Why don't you farmers start secretin' your plans, too? It might make the enemy think you had some super-duper new kind of foods to double the Army's stayin' powers."

"Well," I says, "I've been thinkin' about that a lot, but farmers are too open and aboveboard about everything they do. They have to go right outdoors from seedin' time to harvest where everybody can see 'em operate. But just the same, we belong to a big secret society and don't know it."

"What's that?" asks the stockyards man.

"Well," I says, "We're steady partners with old Dame Natur' and she's so close-mouthed about her plans all the time that us farmers don't need to be secret our own selves. Fact is, we don't know what's headin' our way on the weather calendar much of the time, and future crop yields are mostly a big mystery. Why, there's more secrets out there on my old eighty acres and hid up

in my seed bin than anything Congress or the high military tribunal can cover up at Washington in a month of Sundays," I says.

"Uh-huh," says the stockyards man, "It surely looks like you and Natur' and the Government will keep the rest of us guessin' after all."

Which brings me full blast into the subject assigned. If we would stop berating authorities for necessary secrecy long enough to think things over, we would agree with Jonathan and his friend, the stockyards man, that you can't find much in the secrecy line to beat the unpredictables of natural growing things or to equal the unsolved mysteries of the soil and the seasons.

We have been prone to take things for granted hereabouts in our civil life of humdrum standardization and panicky when little upheavals arise to disrupt some traditions associated with customary procedure. In thus doing our daily dreadfuls we have overlooked the self-evident facts of life, including the truth that we know not where we came from ourselves, nor whither bound, and that our basic food supply is not so simple as it looks arranged on the grocery shelves, being itself a product of forces and solvents and reactions yet but partially known and none too well secured. Jonathan was dead right when he said that the seed bin and the springtime soil hide a bigger mystery and carry more uncertainty than Congress.

BEFORE going further we can state the one place where Government plans and farm policies meet on the border line of the unknown realm of the future—the one bright and sure certainty perhaps in the whole category of things yet to come. It is this: The Government and the Army know that you invite disaster when your men are poorly trained and equipped or your attacking force comes too little and too late. Likewise, the farmer knows that unless he follows at least the bare necessities of culture, uses fairly good germinating seed, and has his land in ordinary shape, he is going to get licked at harvest. Beyond knowing these awful truths to build on as a starter, neither the Government nor the farmer can do more than hope and pray for the success of the campaign or the magnitude of the crop.

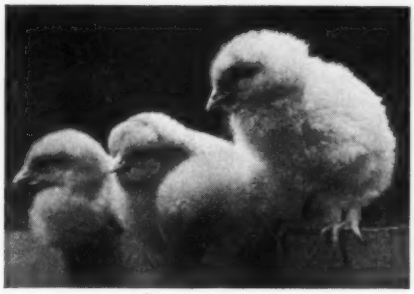
But to get into that desired state of preparedness for eventual struggles, both the armed forces and the food providers must have the best of information. Information in the Army is secured by a complex "intelligence" department, some branches of which spy on the enemy and others do research work to perfect offense and defense.

Similarly, we of the food-building corps must and do possess our intelligence service, operating through many state experiment stations, government laboratories, and private channels. Its function has been to discover secrets within the vast realm of the plant world so that commercial value might be obtained from vegetation and the animals which derive their life sustenance from vegetation. In spite of all this "big talk," we are still groping in many mysteries.

FOOD and fiber builders, like farmers, are so often unaware of the secrecy and mystery surrounding them that they lack full appreciation of the forces with which they deal. One need name only a few things that make agriculture so much of an unknown quantity to see how true it is that secrecy is the rule rather than the exception in life.

From the towering pine he hopes to saw into timber for a barn clear down to the lowly form of plant life which ripens his cheese, the farmer is steeped in a continual maze of mystery and uncertainty. Of course, he can copy down an axiomatic definition in answer to the query, What does it mean to be alive? He can reply, "A living plant or animal has ability to take in outside material and to transform this material into substances like itself, so that it is nourished and kept alive, grows from within, and reproduces its kind."

But the farmer and his soil are more concerned directly with another question arising from the first one, and that is, "Why is plant culture the basis of agriculture?" Here again he can get a dogmatic answer which only stirs the surface and yields further dilemma—"Green plants manufacture food from raw materials and chemical formulas found in sun, air, and soil; while animals and colorless plants are unable to make their food from such bare raw materials."



That makes the farmer feel mighty big and important for awhile because he must be the go-between, the animating and managing director in this process of growing the plants so that when they are ripe they can be utilized by the two-legged and four-legged species to which the farmer himself is related. But before he gets too sure that he knows the whole secret, he runs up against a couple of tough-looking babies, photosynthesis and chlorophyl. Before he can swallow hard and get his eyes focused back to normal again, he realizes that the Army and the Navy and the Marine Corps plus every bureaucrat in Washington have nothing on him for secrecy.

He finds that as soon as his cereals and vegetables begin to "show green" they start up a factory business more complex than anything going on over in the munitions plant. They take the carbon dioxide from the air and the water from the soil and mix them up somehow in those tiny green-celled chambers, using sunlight as the dynamic energy to make an inorganic element into sugars and starches. Most any scientist is prepared to exhibit slides and texts galore about this everyday agricultural process, but we haven't met any of them yet who can explain it well enough to reproduce the crops by artificial gadgets.

Looking further, the farmer meets other puzzles. When he tries to figure out how all that soil water with its fertilizing chemicals got inside the root hairs and tissues of the plant, some wise guy tells him it is caused by "osmosis;" but that's as far as the wise guy ever gets, and this is another mystery for our collection. On top of that, the farmer wonders how in tarnation it happens that all this plant sap keeps moving up and down through the leaves, stems, and roots, and how a pine tree ever gets its top needles fed from the earth so far below.

Maybe a scholarly friend will seek to explain it by saying that sap moves because of the pulling power of leaf transpiration. But if that extends much light on the constant operation of those inner elevators up and down a plant, then I'll let you guess awhile. Folks who think of plants as motionless might as well move over and take the next bus, 'cause they've missed this one.

Then in spite of all the photosynthesis and sap running and osmosis and transpiration, the farmer gets to know by experience that he's expected to keep a well-stocked soil larder on tap for all his agricultural plants. As he starts in to find out what his land needs and his plants like most, he runs smack-dab up against a whole Library of Congress full of items he doesn't know and science hasn't discovered yet.

Of course, in general he gets to know that nitrogen is good for crops that are grown for their leaves, that phosphorus hastens crop maturity, that calcium overcomes harmful acidity, and that potassium improves plant vigor and helps resistance to disease. If he tries to get too chummy with a lot of the old-timers and experts in the plant-food business, he'll find them at odds and

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Hogging off corn and peanuts produces pork profitably and is one of the best soil-improvement practices known.

Fertilizing Peanuts in Georgia

By J. Lloyd Burrell

Agricultural Extension Service, Athens, Georgia

THE peanut crop has recently become very important since peanuts are a good source of oil now being increasingly demanded, not to mention other food and feed which they can furnish directly or indirectly.

In 1941 some 670,000 acres of peanuts were harvested for nuts in Georgia, and 431,000 acres were used for other purposes, mostly hogging off. The per-acre yield was 785 pounds; but many farmers, through using good cultural practices, including fertilization, produced from 1,200 to 1,500 pounds per acre.

Essentially, the good cultural practices for peanuts, according to E. D. Alexander, agronomist for the Georgia Agricultural Extension Service, include planting on adapted soil, rotating with highly fertilized crops, thorough soil preparation, use of good seed, proper fertilization, close spacing, thorough cultivation, and the use of good harvesting and curing methods.

All sections of Georgia are adapted climatically to peanuts. Sandy loam to sandy clay loam types of soil are best. However, most soils, with the exception of heavy clays, will produce peanuts provided there is good drainage. When peanuts are planted for hogging off, the lighter or sandier types of soil should be used since the heavier or clay types will puddle and be injured if grazed wet.

To obtain satisfactory yields, Mr. Alexander explains that good stands are necessary. Securing good stands begins with preparation of the soil. Land for

peanuts should be thoroughly broken and harrowed a sufficient number of times to make a smooth, well-prepared seedbed with as little surface vegetation as possible. Land previously in lespedeza, cowpeas, soybeans, velvet beans, weeds, or light growths of grass which will decay rapidly when turned under is easier to get into condition for peanuts than areas previously in crops such as cotton, corn, or heavy growths of grass which leave slow-decaying plant residue.

If the peanut crop is to follow a winter legume or other green cover crop, the cover crop should be turned under 10 days to 2 weeks before the peanuts are planted. All weeds and grass possible should be killed before the crop is planted. Harrowing or disking frequently previous to planting is necessary, and the soil should be thoroughly harrowed or disked just before the seed is planted.

Mr. Alexander points out that the response of peanuts to fertilization has varied a great deal in the various states and in different sections of Georgia. An application of 200 to 300 pounds of fertilizer such as a 3-8-6, 4-8-6, or 3-8-8, depending upon the fertility of the soil, should give good results with Spanish peanuts. In the more fertile soil, if fertilizer is to be used, an application of 150 to 200 pounds of an 0-14-10 or 150 pounds of 16 per cent superphosphate and 40 to 50 pounds of muriate of potash or their equivalents per acre should be sufficient. It is generally agreed, however, that if peanuts are grown in rotation with other crops which have been fertilized with good amounts of fertilizer containing high percentages of nitrogen, phosphoric acid, and potash, such as cotton and tobacco fertilizers now being recommended, and where well-phosphated cover crops are used, little profit is obtained by the use of extra fertilizer applied direct to the peanut crop.

North Carolina Runners are seldom fertilized and there is little information on fertilizing this crop, but if fertilizer is thought necessary, 150 pounds of 16 per cent superphosphate and 40 to 50 pounds of muriate of potash or their equivalents are suggested. These fertilizer materials will replace a part, at least, of the plant-food elements removed by the peanut crop.

Tests with Spanish peanuts over a 10-year period at the Coastal Plain

Peanuts should be clean cultivated from the time the plants appear until they cover a good portion of the ground, and laid by on a slight ridge.

Experiment Station, Tifton, Georgia, show that good increases in yields can be obtained from the use of 200 to 400 pounds of a fertilizer containing 2 to 4 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 4 to 6 per cent potash. The Georgia Experiment Station, Griffin, Georgia, in tests made on farms in the peanut area and at the Station got good increases in yields from the use of 300 pounds of a 3-8-8 and 100 pounds of nitrate of soda as a side-dressing.

Spanish and North Carolina Runners are the leading varieties grown in Georgia. The Spanish is grown largely for shelling and oil, but some are planted for early hog feed. The small, white Spanish is the variety or strain desired by the trade. North Carolina Runners are planted mainly for hogging off, but some are planted for oil.

For best stands and yields, peanuts should be planted as soon as the soil becomes warm, the Georgia Extension agronomist recommends. The best

Good stands of peanuts are necessary for profitable use of fertilizer.

In order to prevent injury to the seed, fertilizer should be applied in the row and mixed with the soil a few days before planting and in such a manner as not to come in direct contact with the seed. Poor stands of peanuts or unfavorable weather will give little return for any fertilizer applied.

Whenever possible, clean, bright, well-filled-out, disease-free seed should be used for planting. Seed of uniform size will feed through the planter more evenly than seed which is not uniform in size and shape. If pegs are to be planted, the No. 1 grade should be used. However, peanut plants from pegs are weaker than from better seed and are slower in getting started.

planting dates for Spanish seem to be April 1 to 15 in south Georgia, and April 15 to May 1 in north Georgia. North Carolina Runners can be planted a week or 10 days earlier. Yields will be greatly reduced if peanuts are planted late.

Peanuts should be planted in shallow furrows on a well-prepared seedbed and covered 1½ to 2 inches on light sandy soils and 1 to 1½ inches deep on heavier soils. Late plantings can be planted deeper. Also, seed should be planted deeper when the soil is not moist. Other things being equal, spacing of plants has more to do with yields per acre than any other factor in peanut production.

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Boron Stopped Fruit Cracking

By J. C. Burtner

Agricultural Extension Service, Corvallis, Oregon

EACH year is adding to the knowledge of the role of the so-called minor elements in soil fertility. Among these half dozen or so minor elements one of the most interesting in its effect is boron, usually applied in the familiar borax form.

As the result of experiments carried on at the Oregon State College Experiment Station, boron is already commercially used in the Pacific Northwest in the control of such troubles as celery stem crack, beet canker, and yellow top of alfalfa. Recent experiments go still further and indicate that boron applied to soils deficient in this element has a pronounced effect on controlling the cracking of cherries and prunes in rainy weather.

It is well known to fruit growers that a tree of ripe cherries, prunes, or plums is likely to suffer a heavy loss from cracking if caught in a rainy spell of any duration. Having found that boron apparently has a pronounced effect on elasticity of plant tissues, W. L. Powers, head of the soils department at Oregon State College, decided to attempt control of this cracking difficulty with a boron application. The idea was tried out first in 1941 with an application at the rate of 30 pounds per acre on a test area in a prune orchard. An unusually rainy fall was experienced, resulting in a 25 per cent cracking of prunes in the untreated portion of the orchard. Where the borax had been applied, the loss from cracking amounted to only 9 per cent.

Similar results were obtained in limited tests with Bing cherries, which had previously cracked severely during rainy weather but which came through a rather wet June in 1941 with little or no cracking of commercial importance. The same effect was observed where boron had been applied to an alfalfa field which was adjacent to a cherry orchard. Those cherry trees which were directly beside the alfalfa field showed markedly less cracking than those farther away.

Dr. Powers points out that these results are quite preliminary and require further proof. The indications are so promising, however, that he believes tests on a field scale would be justified in view of the relatively inexpensive nature of the trials.

The Way to Test

The recommended application of 30 pounds of borax per acre is usually made in the early spring. A fair test would be to apply the material to two middles involving three rows of trees, while two adjacent middles are left untreated to compare picking tests of the interior rows.

Tests started in 1940 have also revealed that a borax application at the rate of 40 pounds per acre greatly reduced the growth cracks in carrots grown on peat land. The carrots grown on the untreated land showed a 10 per cent loss from cracks, while on the treated plots the cracking amounted to only 4 per cent. In 1941 the difference was even more marked, with the untreated plots showing 11 per cent loss and the treated plots only 1 per cent. Cracking and canker on broccoli and asters have also responded to boron.

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Permanent Hay—
the Plant Food Way

By A. R. Midgley and D. E. Dunklee[1]

Agricultural Experiment Station, Burlington, Vermont

ON MOST dairy farms chemical fertilizers and manure are primarily used on the corn crop. Furthermore, the fertilizer is usually placed so close to the corn plants that they get most of this added fertility. Under such circumstances oats, clover, and timothy which follow in rotation receive only the plant food left by the corn.

Ordinarily this fertility lasts only two or three years. The yield and quality of hay rapidly decline thereafter in spite of occasional top-dressings of manure, and finally ebb so low that the farmer is compelled to plow again and repeat the same rotation. Such a scheme is apt to be characterized by several years of hay hardly worth cutting and leads to the prevailing thought that a field of run-off grassland needs "the plow."

Formerly, it seemed that the farmers were correct, that the only sure-fire method of attaining better hay was plowing and rotating more often, growing more corn, and fertilizing it more heavily. Now, however, good permanent hay on many fields seems to be a better way.

To some readers permanent hay might imply worn hayfields covered with brambles, brush, and goldenrod and given to the neighbor for the expense of harvesting. Such fields usually have not received fertilizer and, therefore, should not be taken as a measure of what plant food can accomplish.

There are many good reasons why permanent hay is an advantage over the present method of hay production and why it has a place on many farms. First, there are often serious obstacles to plowing, especially on many New England farms. To plow heavy clay soils in the spring is almost impossible because the plow gathers wet clay like a snowball. This puddles, the soil forms hard clods, and makes a poor seedbed. Also, in the summer, the clay dries out and toughens up brick-hard, making plowing impossible. Fall is about the only time when the moisture is just right to leave the seedbed in good condition. Fall plowing, however, has the disadvantage of leaving the soil bare and unprotected during the winter.

Plowing on upland hay farms is likewise a drudgery, hampered by hidden stones and blocked by boulders and rock piles that restrict the length of furrows. Even where rocks do not trouble, the fields are often too steep or too wet, most of the year, to be readily plowed. Elimination of such tough and expensive plowing would provide a considerable saving with which to buy plant food.

Furthermore, it would be an advantage to reduce corn acreage on heavy clay soils, since at best the crop never grows too well and sometimes almost fails. Corn, too, is not very well adapted to wet land nor to localities bordering Canada which have too short a growing season. In such areas where hay is desired and where land is usually plowed up and seeded back down to hay as soon as possible, permanent hay is a logical goal.

Another good reason for maintaining permanent hay is to avoid erosion. In fact, a good sod is nature's best protec-

[1] Research Agronomist and Assistant Research Agronomist.

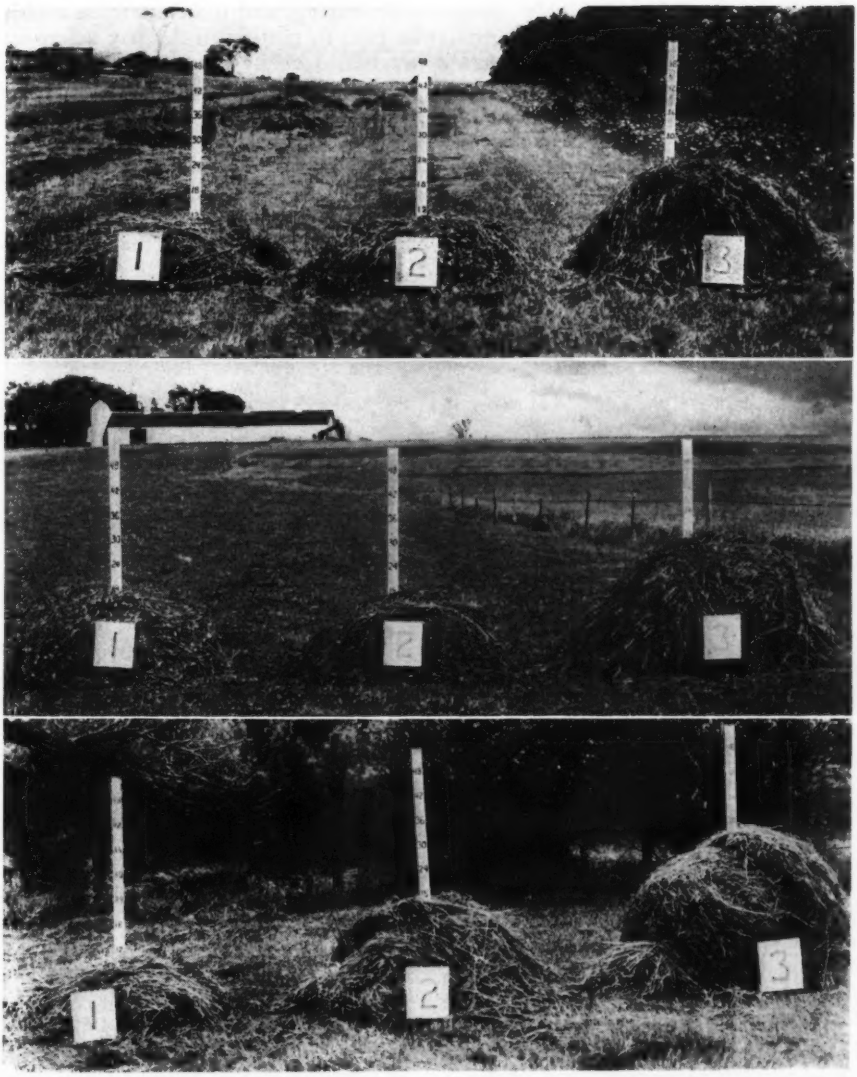

Fig. 1. The effect of untreated check (1), nitrogen alone (2), and a complete fertilizer (3) upon hay yields from similar sized plots on Addison clay loam (top), Colton fine sandy loam (middle), and Suffield silt loam (bottom). The complete fertilizer was outstanding in performance while nitrogen alone was not enough.

tion. Plowing soils in the fall, especially clay soils, exposes them to erosion during the winter even though the slope may not be very steep. In New England there are also many steep fields on which any very extensive plowing at any one time exposes the soil to the formation of rills and gullies. Such loss of soil is always serious and doubly so where not more than 18 inches cover the ledges, as is sometimes the case. Once permanent hay has been established, pelting summer showers will find no steep cultivated fields of corn to beat upon and wash away soil. A hay sod intercepts the raindrops and filters them off harmlessly. For erosion control, permanent sodded waterways are

also recommended and highly desirable. Under all such conditions permanent hay is not only desirable but essential if the soils are to be left in good condition for generations to come.

Permanent hay is also desirable because it is a soil-building process. Some of the very best soils in the country, those in the Midwest, were built up by continuous grass over a period of centuries. Grass builds up organic matter, while frequent plowing and cultivation destroy it through oxidation.

The writers do not propose the elimination of corn from fields where it is well adapted, because in some years of short hay crops, 1941 for example, corn may be a lifesaver. It can provide large quantities of feed when hay fails. The idea is mainly to eliminate it from those acres with serious obstacles to growing it. Nearly every farmer has some land that is primarily adapted for hay purposes.

On many farms permanent hay probably should partly displace corn. On others, new developments in the ensiling of grasses may make it possible to practically eliminate corn and substitute grass ensilage. In such cases, machinery for planting, harvesting, and cultivating corn would not be needed. Corn cultivation would not interfere with haying, and more attention could be paid to putting in the hay before it was damaged by rain.

Permanent hay when properly harvested makes better feed, is more digestible, more palatable, and richer in bone-building minerals and protein by reason of the extra plant food of necessity employed to grow it. Furthermore, it is generally recognized that less labor and expense are involved in growing hay than in growing corn, a fact that will bear more weight as the Victory Program makes farm labor ever more scarce.

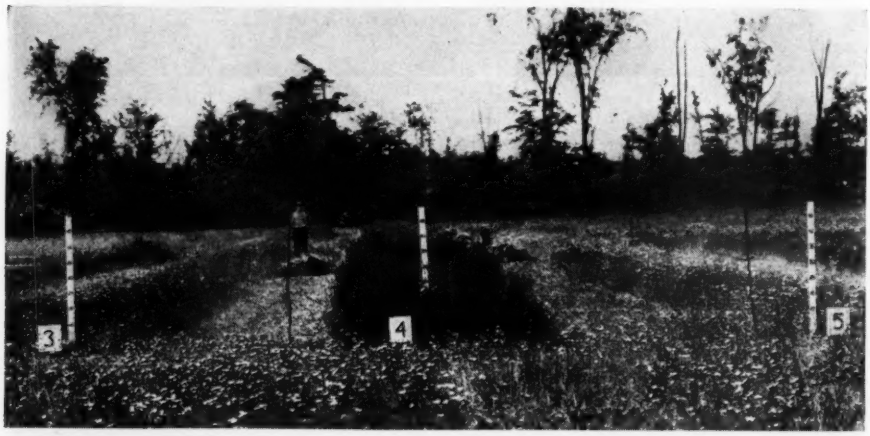

Fig. 2. Effect of fertilizers on an old sod. Nitrogen only (3), complete fertilizer (4), and no treatment (5). Complete fertilizer without seed changed the vegetative cover of poverty grass and weeds to desirable hay plants—timothy and clover.

Five years ago experiments were initiated at the Vermont Agricultural Experiment Station to find out if commercial fertilizers would prolong the productive life of hay for a year or two, and perhaps even longer. Five hay fields on scattered farms representing clay, loam, and sandy soils were selected for test plots. Some were producing good timothy hay at that time, while others were more or less worn and beyond the likelihood of again being made productive without plowing and reseeding. On each field, fertilizer applications were broadcast evenly over the sod each succeeding year. To determine the relative merits

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The Production and Use of Potash in America

By R. H. Stinchfield

Washington, D. C.

WITHOUT potash, there would be no plant and animal life, because potash is one of the essential plant foods. Whether you live on a farm or in a city apartment, your welfare depends upon an adequate supply of this mineral, not only because of the plant products which you consume and wear but for the animal products without which our modern civilization could not exist.

It therefore has been deemed particularly fortunate that this continent is now independent of any foreign sources for its requirements of potash. Such was not the case during the first World War, prior to which almost all of this country's potash came from German mines. When the United States entered that war and these supplies were cut off, prices of potash rose from $35 per ton to $350 and in some cases $500 per ton and there was little to be had at any price. Growers became desperate in their efforts to get the material in order to meet the increasing demands for food. Out of that emergency came the roots of an American potash industry which has grown through the intervening years to a point where in this war lack of potash will not impede America's march to victory.

The Role of Potash

To fully realize how essential potash is to everyday life and particularly to the increased demands for food in any war effort, something of just what potash is and its role in plant life must be understood. According to Van Slyke, noted plant-food authority, the element potassium is never found in nature uncombined, only in compounds. It is a constituent of many minerals, and much of the potassium in the soil is not in a form available for plant growth. The word potash is almost universally used in agricultural literature referring to potassium compounds.

Plants require the element in relatively much greater quantities than do animals. It forms a larger part than any other mineral element in the ash of plants. While the role of potash has been the subject of intensive research for more than 100 years and still continues to be, it is known that potash is vital to the formation of starches and sugars and their transference to the storage parts of the plant. It is also necessary in protein synthesis and appears to be involved in a number of other reactions in the plant, many of which are not fully understood. Potash is credited with making the cell wall stronger and in the case of supporting tissue, makes the wall thicker. This gives strength to the stem parts of the plant, a particularly important feature in grain and fiber plants. It is also known that potash increases disease resistance of plants and enables them to better withstand unfavorable weather conditions, such as droughts and early frosts.

In fulfilling its numerous functions in the plant, potash exerts considerable influence on many of those factors which go to make up what is termed quality of the crop. It has been shown that by the use of sufficient amounts of potash, the shape, size, and cooking qualities of both Irish and sweet potatoes are greatly improved. Sugar beets

and other root crops produce a better shaped root and usually have higher percentage of sugar. In the case of cabbage, potash produces a firmer, tighter head, and kraut made from the crop has a much better flavor.

The effects of a good supply of potash on cucumbers are very striking, the fruit being well shaped, while they are pointed and frequently club-shaped when insufficient potash is used. Tomatoes produce a fruit which is firmer, with more meat, better color, and more even maturity. There is less tendency for the fruit to crack. Celery is firm and crisp instead of stringy and tough. In the case of strawberries, potash gives the fruit more color and flavor and makes it carry much better, so that it comes on the market in a more desirable condition. Apples and peaches have a richer color and flavor and will keep longer in storage. Oranges that can get plenty of potash have a thinner rind and a much higher juice content.

A large amount of experimental work has shown very strikingly that potash is the biggest single factor in determining the quality of tobacco leaf. It improves the body and texture of the leaf and greatly improves the burning properties. The plumpness and test weight per bushel of wheat and other grains are increased by potash fertilization. It influences the protein and grazing quality of pasture by favoring the growth of clovers and legumes. Legumes have a very high potash requirement and when they cannot get enough of this nutrient, they tend to be weak and soon die off.

It has been shown that potash will increase the length and strength of cotton fiber, as well as increase yield and proportion of lint to seed. It controls cotton rust and aids in the control of wilt. With corn, potash reduces lodging of the plants and chaffiness of the ears. In the case of peas, the seed coats are more tender. Among the many other crops recorded as showing marked response to potash are prunes, apricots, walnuts, hops, cantaloupes, flax and grapes. This great influence of potash on the various factors entering into the quality of the crop has caused this nutrient to be termed the "quality" element in the fertilizer.

Potash in Fertilizer

In the fertilizer trade potash is signified as K_2O and is frequently used synonymously with potassium. Most of the potash used in the fertilizer in this country is in the form of potassium chloride, known in the fertilizer trade as muriate of potash. Since a majority of the soils which need fertilizers lack potash and frequently nitrogen, as well as phosphoric acid, most of the potash is applied in mixed fertilizers containing the other nutrients. In the plant-food analysis statement printed on every fertilizer bag, the first figure refers to the percentage content by weight of nitrogen, the second figure to the phosphoric acid, and the third figure to the potash. Thus a 3-8-8 fertilizer would contain 3% nitrogen, 8% phosphoric acid, and 8% potash. The analysis is always given in the same order.

Use of Potash

Industries using potash include the chemical industry, tanning and dyeing, electroplating and photography. Potash is needed for medicine, metallurgy, and the manufacture of glass, soap, matches, paper, and explosives. However, more than 90% of all the potash produced is used in fertilizers.

The first use of potash in agriculture is not recorded. It is known that long before this country was colonized, the Indians had discovered that on spots where there had been a bonfire, plants grew better, and in Europe and Asia wood ashes, which contain from 3 to 8% potash, had been used on gardens for centuries. America's first potash industry grew out of the burning of great quantities of wood cleared by the Colonists and the leaching of these ashes in pots (from which it is assumed the word potash originated). This potash was used for making soap, gunpowder, and glass, and was exported to the older

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Mississippi Studies Cotton Fertilizer

By J. I. Hurst

Southwest Junior College, Summit, Mississippi

SINCE 1937, the Mississippi Agricultural Experiment Station has conducted a fertilizer analysis test with cotton in cooperation with the Southwest Mississippi Junior College, Summit, Mississippi. The soil on which the test has been conducted is a grey upland soil of a silty texture, and somewhat cold in nature. In 1935 and 1936 this land had been planted to oats which were cut for hay, and both years the oats were followed with sorghum which was cut for silage.

This land had not been planted to winter legumes previous to 1937, but since then has been planted to Austrian winter peas, and a blanket application of 400 pounds of basic slag per acre has been applied each year in addition to the fertilizer applied under the cotton at the time of planting. The peas were plowed under in the spring in time to plant the cotton during the latter half of April, usually from April 20 to 25. With the exception of 1940, the stand of cotton was fairly uniform. The fertilizer was applied at the rate of 600 pounds per acre except on one plot which did not receive any fertilizer. The 4-8-4 treatment was used as a check and appeared three times in each of the three series included in the test.

The discussion of results will be as follows: First, the effect on the yield of seed cotton by increasing nitrogen applications, with a constant application of phosphorus and potash; second, the effect on the yield of seed cotton by increasing phosphate applications, with a constant application of nitrogen and potash; and third, the effect on the yield of seed cotton by increasing potash applications, with a constant application of nitrogen and phosphate.

Each year as the nitrogen was increased from no nitrogen to 4%, the yield of seed cotton increased. In every year except 1940 and 1941 there was an increase in yield as the nitrogen application was increased from 4% to 6%, but there was a decrease in the yield of seed cotton as the nitrogen application was increased from 6% to 8% every year except 1939 when 8-8-4 produced 7 pounds of seed cotton more than the 6-8-4 plot, and 1941 when it produced 5 pounds more. It is reasonable to believe that the results would have been more noticeable if the winter peas had not been grown.

Effects of Phosphate and Potash

In those plots where phosphorus was the variable element, there was an increase in yield of seed cotton every year except 1940 and 1941 on the plot receiving the 4% application as compared with the no-phosphate plot. In every year there was an increase in yield as the phosphorus was increased from 4% to 8%, but in every year except 1941 a decrease in yield resulted when the phosphorus application was increased from 8% to 12%. The increases in yield of seed cotton as a result of the phosphorus applications under the cotton at time of planting probably would have been larger if 400 pounds of basic slag per acre had not been applied to all of the plots every year. In general, when the percentage of phosphorus was increased, there appeared to be an increase in the quality of the bolls and somewhat earlier maturity. This may

TABLE I.—ANALYSIS TEST WITH COTTON, SOUTHWEST JUNIOR COLLEGE, SUMMIT, MISSISSIPPI

Treatment 600 lbs. per acre	Yield in pounds of seed cotton per acre					5-year average
	1937	1938	1939	1940	1941	
No fertilizer	230	225	404	717	417	399
4–8–0	531	405	614	1,112	600	652
4–8–4	881	1,170	1,243	1,252	1,068	1,123
4–8–8	1,112	1,571	1,683	1,129	1,251	1,351
4–8–12	1,184	1,706	1,813	1,077	1,299	1,416
4–0–4	567	873	1,115	1,158	1,092	961
4–4–4	725	986	1,224	1,128	990	1,011
4–12–4	878	1,013	1,201	1,223	1,092	1,081
0–8–4	770	972	1,206	1,210	1,005	1,033
6–8–4	954	1,247	1,370	1,162	963	1,139
8–8–4	945	1,170	1,377	1,116	968	1,115

account for the high rank of 4-12-4 in the yields of 1940, a year in which the boll-weevil was very active. No poisoning was done in 1940, as it rained every day during the time poisoning should have been done.

The yield of seed cotton was greatly increased by an increase in the application of potash in the first three years of the test. In 1937, the 4-8-0 (no potash), 4-8-4, 4-8-8, and 4-8-12 plots yielded 531, 881, 1,112, and 1,184 pounds of seed cotton per acre, respectively. In 1938, the 4-8-0, 4-8-4, 4-8-8, and 4-8-12 plots yielded 405, 1,170, 1,571, and 1,706 pounds of seed cotton per acre, respectively. The results in 1939 showed increases for potash applications similar to those in 1937 and 1938, but in 1940 the 4-8-12 yielded less than the 4-8-8 and the 4-8-8 less than the 4-8-4. This was a result of the wet season and rank growth on these plots, which made ideal conditions for boll-weevil damage.

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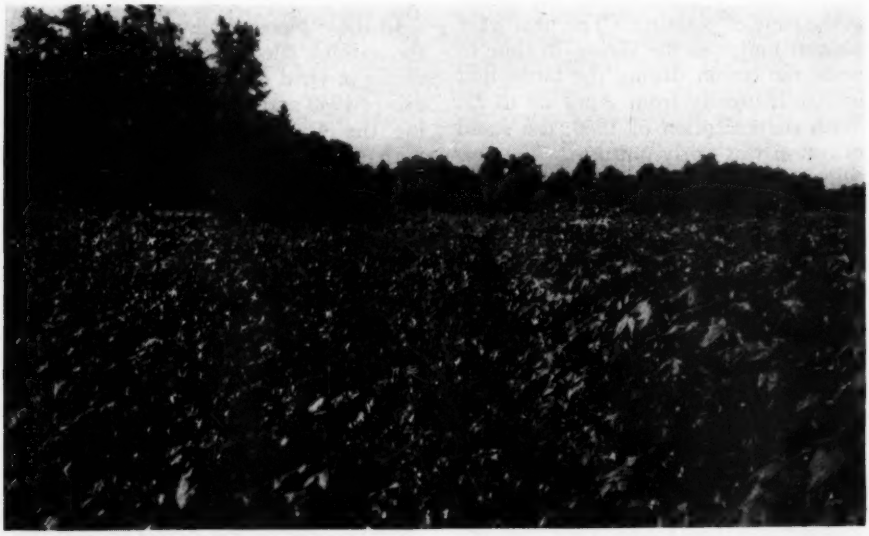

A view of the cotton tests at the Mississippi Station. Fertilized with 4-8-0 (left) and 4-8-8 (right). Note prevalence of rust on plot receiving no potash.

Modern Fruit Production

(A Book Review)

A NEW book on fruit growing is a real contribution to the literature on horticulture. The authors are J. H. Gourley and F. S. Howlett of the Ohio State University, and their book is entitled "Modern Fruit Production" (The Macmillan Company, New York, 1941. $4.50). The authors have drawn on their broad training, experience, and travel to write a book that lives up to its name of modern. The general outline of their approach to the subject is conventional, but their treatment of the various subjects reflects changes in fruit growing, the significance of which does not appear to be recognized by many horticulturists.

The first chapter is a general introduction, and might be termed the geography of fruit production. The next two chapters furnish fundamental background information necessary for the intelligent management of fruit trees or plants. One chapter covers rather thoroughly the structure or anatomy of fruit plants, and the other is devoted to the functioning or physiology of the plants, with particular reference to the fruiting parts. Chapters four and five consider the establishment of the orchard, including the site, soil, arrangement of trees or plants, and sources of trees.

The next three chapters take up factors affecting the health, vigor, and growth of the trees. One of the chapters treats mainly the soil organic matter and the orchard cover; chapter seven is devoted to fertilizers and manures; while chapter eight has to do entirely with water, in the plant, in the soil, and the control of soil moisture. Pruning of all types of fruits is taken up in detail in chapter nine. Fruit setting and factors affecting it are covered in chapter ten, while the next chapter treats with fruit thinning and alternate bearing. The twelfth chapter considers the harvesting, handling, and storage of fruits; chapter thirteen is devoted to the various aspects of winter injury to fruit trees and plants.

Nutrient deficiencies and physiological disorders are the subject of chapter fourteen. The next chapter covers the propagation of fruit plants from seed and cuttings, with most attention given to grafting methods and fruit stocks. Chapter sixteen takes up the origin of the various fruits, and how they have been or may be improved. The last chapter considers the economic aspects of fruit production as a business.

Information Up-to-date

It has been said that a book is always out of date as soon as it is written. This book is an exception to that statement since the authors have included in their book a surprisingly large number of recent findings. Instances of these are too numerous to give in their entirety, but a few will be mentioned. The principles of thin wood pruning and graduated space thinning, which appear to be significant improvements over older arbitrary methods, are explained. Recent work on soil conservation and erosion control is utilized in the chapter on laying out and planting the orchard. The great importance of maintaining and increasing soil organic matter, if the orchard is to be kept in a productive condition, is stressed.

The newer concepts of mineral nutrition in orchard management are given more attention in this book than in any so far published in this country. The latest developments in the use of phosphorus, potassium, boron, magnesium, zinc, and calcium and the effects of deficiencies of these and of nitrogen are given in quite some detail. Chapters seven and fourteen, dealing with these

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Fewer and Higher Fertilizer Grades

By T. K. Wolfe

Director of Distribution, Southern States Cooperative, Richmond, Virginia

HIGHER analysis fertilizer has new and added significance in wartime. Through its use farmers save money, time, labor, and transportation. Now it is not only sound economy for farmers to use higher analysis fertilizer, but it is patriotic—because of the saving in shipping space and labor in manufacturing and distribution.

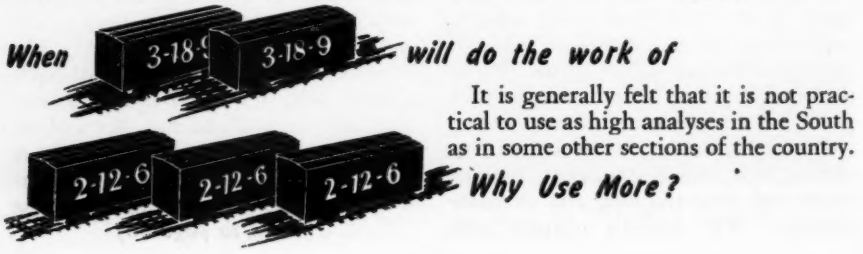
M. H. Lockwood of Eastern States Farmers' Exchange has played a leading role in furthering the production and use of higher analysis fertilizer, particularly in the New England States. He has shown that: (1) In general, the consumer cost per unit of plant food decreases as the percentage of plant food in the fertilizer increases. (2) The proportion of the total cost the consumer pays for manufacturing, packaging, and distribution decreases rapidly as plant food increases. (3) The greatest savings are made when the plant food is increased from 15 units to 20 units.

Experiment stations in the Middle Atlantic States are recommending that fertilizers containing not less than 20 units of plant food be used. The trend of legislation, although slow, is toward requiring the use of fertilizer higher in plant food.

Some years ago 2-8-2 was the leading analysis of fertilizer. It is now largely forgotten. It is not legal to sell it in most states. In its place 4-16-4, a double strength 2-8-2, is being used in increasing quantity. Even 3-8-3, for a long time so popular in the South, is now losing much of its popularity; and more 4-12-4, which has practically the same ratio of plant food, is being used. Total content of the plant food may be increased also by adding more of one or two nutrients, thus changing the ratio. For example, the 4-8-8 is being used in place of 3-8-3 on soils where potash deficiency has become a problem.

Only recently North Carolina made it illegal to sell in that State 3-8-3 and other fertilizers containing 14 units of plant food unless a red tag is attached to each bag setting forth the inadvisability of farmers using fertilizer containing less than 16 units of plant food. Mixed fertilizer containing less than 14 units of plant food cannot be sold under any circumstances.

Southern States Cooperative has consistently urged its members and other farmers to use higher analysis fertilizer. Manufacturing earnings, however, may appear greater in case of lower analysis goods, since plants are usually compensated on the basis of tonnage.



It is generally felt that it is not practical to use as high analyses in the South as in some other sections of the country.

These two analyses carry plant food in about the same ratio; 1,500 pounds of 3-12-6 (left) contain about the same amount of plant food as 2,000 pounds of 2-9-5 (right). Farmers save money, handle 500 pounds less fertilizer, and make shipping space available for ¼ ton of wartime supplies when they use 3-12-6 instead of 2-9-5.

J. J. Skinner of the U. S. Department of Agriculture suggests that fertilizer containing more than from 20 to 25 units of plant food not be recommended for general use in the South for the following reasons:

1. Much of the fertilizer distributing machinery on farms is antiquated and it is difficult to apply small quantities of fertilizer uniformly.

2. On many farms the machinery places fertilizer improperly in reference to the seed. The use of fertilizer too highly concentrated, containing a high percentage of water-soluble materials, may hinder germination of the seed.

With the introduction of improved fertilizer attachments on machines, these difficulties are overcome.

The production and distribution of higher analysis fertilizer containing at least 20 units of plant food is in the interest of farmers. It is the better part of wisdom to move in the direction of higher and higher analysis fertilizer only as fast as farmers can be informed and educated as to its advantages and use. Farmer acceptance is an important consideration, and is largely a process of education. Far too many farmers still purchase fertilizer on the basis of price per ton rather than on the basis of price of plant food. The use of higher analysis fertilizer increases when farmers are told of the advantages they gain in actual savings of money, time, labor, and transportation.

The 2-12-6 analysis is widely used in certain sections. Southern States Cooperative has aggressively urged farmers to use 3-18-9 instead of 2-12-6, and with great success. Two tons of 3-18-9 contain the same amount of plant food as three tons of 2-12-6, and the saving to farmers, on the basis of the prices they pay, is approximately $11. The saving in transportation is shown graphically here. There are also the savings in time and labor of handling. The question is well put: "When 2 cars of 3-18-9 will do the work of 3 cars of 2-12-6, why use more?"

Higher analysis fertilizer gives farmers one of the best means of accomplishing their great desire—to get fertilizer with less sand, with less filler of any kind. For years they have resented the large quantities of sand so widely used in fertilizer. However, in most sec-

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Nutrient Availability

*An Analysis**

By S. R. Dickman

Soil Chemist, Agricultural Experiment Station, Urbana, Illinois

Nutrient Hetoemia [1]

This term is derived from the Greek verb "hetoemos"—to be ready. Hetoemia as used here is considered as the summation of all the factors involved in the absorption of nutrients by plants. This viewpoint may perhaps best be understood if the term is first defined and the implications of the definition subsequently discussed.

The hetoemia of a given plant nutrient is determined by calculating as pounds per acre the average total amount of that nutrient absorbed by a field crop from each treatment in an experiment when no other nutrient has limited absorption.

Nutrient hetoemia in this broad sense is concerned with the essential elements in the whole soil mass. Thus the expression "potassium hetoemia" does not refer merely to the replaceable potassium in the surface layer but includes all the potash the plant absorbed from any depth and irrespective of its original condition in the soil. In other words, this type of abstraction measures the over-all reaction without explicitly recognizing the mechanisms involved in achieving it. It is comparable to the thermodynamic approach in physical chemistry which is concerned solely with energy relationships and completely ignores the actual mechanism of a reaction and the specific factors which determine the rate of the reaction, etc. It seems plausible that the recognition of such a general concept in agricultural science might serve as a sound basis for detailed experiments which would then attempt to separate and describe the various factors in a specific, mechanistic manner.

The definition is stated in terms of field conditions for several reasons. The first is that of practicality. Since the ultimate purpose of nutrient experiments is to secure results which will be of use in making recommendations to the farmer, it is obvious that the final criterion must be field results. This does not mean that other methods are not acceptable; in fact, the search for more rapid, less expensive methods and techniques should be encouraged. But as long as farmers till their land, field results will remain the final basis of judgment. In the second place, all the possible factors in a particular area will be active in the field, while some may be absent or less active under other conditions. A conscious selection of the widest, most complex situation for expressing the concept is the safest way to insure that no factor will be ignored. Yet it can not be too strongly emphasized that other methods, such as "quick tests" and the Neubauer and Mitscherlich techniques, not only are preferable to field experiments for certain investigations but also are necessary for an intensive study of specific factors.

The total amount of an element which is absorbed by a crop throughout the growing season in an hetoemia experiment rather than the yield is selected as a basis of judgment because

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* Continued from March issue of BETTER CROPS WITH PLANT FOOD.

[1] The author wishes to thank W. A. Oldfather, Professor of Classics, University of Illinois, for suggesting the term "hetoemasia." The author has shortened this to "hetoemia".

the two do not always vary proportionately with each other. Many are familiar with experiments in which the amounts of a single nutrient, nitrogen, for example, are varied; all the other nutrients being supplied in uniformly "sufficient" quantities. Because of the "secondary" effects of nitrogen in plant metabolism on the absorption of other nutrients, the grain yield with the lower amounts of added nitrogen will be proportionately greater per pound of nitrogen absorbed, while with the higher amounts of added nitrogen, an excess of vegetative development may proceed at the expense of yield of grain. As a means of treating this discrepancy, the author proposes the introduction of a concept of "feracity" [2] which is defined as follows:

The feracity of a particular plant nutrient is expressed by the average yield of a certain crop on each plot in a field experiment, when no other nutrient has limited the yield.

The NP plot of various soils will furnish data to enable one to compare the "natural" potassium feracities of the soils. The effect of K additions on the potash feracities of the fully treated plots can then be quantitatively evaluated.

Nutrient Important

Especial attention should be given to the role of nutrient in these definitions. Both of these definitions are based on the assumption that the climate, water supply, physical condition of the soil, presence of claypans, depth of the topsoil, etc., are uncontrolled variables in these experiments, the effects of which can be averaged over a period of years so that their long-time effect is essentially constant in any one location. It is apparent that these non-nutrient factors determine the hetoemia and feracity of nutrients in any one region. While theoretically it might be predicted that potassium hetoemia would not be the same on two different soils, practically these differences might be insignificant on similar soils of a region, so that conclusions based on one soil could be generalized to cover similar soils in that area. The potential hetoemia and feracity of the phosphorus in a bag of fertilizer will depend on the particular soil to which it is applied, the kind of crop to be grown, etc. Since experimental set-ups in different areas may have one or more of these factors different, we are forced to devise a concept which can accommodate the wide variations found in the field or give up general notions altogether. The fact than two soils differ markedly in their physical constitution should not hinder us from carrying out fertility experiments on them with as accurate a nutrient control as can be devised. Indeed, it is this recognition of field differences which precludes the possibility of answering fertility problems solely by greenhouse or laboratory experiments.

Future fertilizer experiments should be planned so that there is but one nutrient variable in any system of treatments. One nutrient should not be a limiting factor while another one is varied. A phosphate experiment on potassium-deficient soils will lead to no justified conclusions concerning phosphate hetoemia or feracity in that soil. Likewise, the hetoemia concept ceases to apply in those situations where yield increases no longer result from further absorption of the nutrient by the plant.

As was mentioned before, the hetoemia and feracity of a nutrient are over-all values. In order to understand how a certain value was secured, it is necessary to analyze the various factors which contributed to it. Many of these factors have been called kinds of "availabilities" by Fraps (14) and by Spencer and Stewart (31) as though they were independent variables. That they are not can be illustrated by an example.

A high percentage of the total potash in most soils is in such an insoluble form that plants can utilize but very small amounts of it in any one grow-

[2] The author wishes to express his appreciation to W. A. Oldfather for suggesting this term.

ing season. According to the present terminology, this potash would be said to have a high positional availability but a very low chemical availability. On the other hand, in those soils which contain significant amounts of replaceable potassium in a claypan layer beneath the surface, potash is said to have a low positional availability but a high chemical availability. If crops were grown on two such soils, potash availability as measured by plant analysis might be very low on both. It seems inconsistent to admit that a certain kind of availability can be high in a soil and yet find that the total availability is very low. It might be less confusing to consider the so-called kinds of availabilities as interdependent factors, each contributing to and affecting the net absorption.

It is in this interrelated sense that the following factors are included in the hetoemia-feracity concepts:

1. Chemical. A recognition that the essential elements occur in the soil in various chemico-physical structures some of which are significantly utilizable by plants, others not. Research in this field is concerned with describing these structures (forms) and determining their value as sources of plant nutrients. When once the principal nutrient forms of the elements have been established, the next step is their quantitative measurement in various soils. As Bray (7) has pointed out, a calibration between the amount of a nutrient form of an element found in a soil by a chemical test and crop yields on soils containing various quantities of this form provides a very practical means of relating laboratory determinations and field data. For example, the original Illinois potash calibration was based on the observation that corn did not respond profitably to further potash additions on soils which contained over 150 pounds of replaceable potash per acre.

2. Positional. Fertilizer placement experiments are primarily concerned with the accessibility of nutrients. A study of different rates of application for each fertilizer in combination with different methods of placement will furnish feracity data that will make possible a quantitative evaluation of the placement-accessibility factor. The lowest weight of each fertilizer that helps produce equal feracities with each method of placement will enable one to judge not only the amount of fertilizer to add but also the most effective placement of it to attain any desired level of crop production.

3. Physiological. A measure of the comparative absorbability of nutrients can be made when the chemical and positional factors are held constant and the variety or species of plant is the only variable.

Feracity Concept Applications

Let us suppose that a soil chemist is in charge of directing experiments in an area known to be markedly deficient in available forms of phosphate. How shall he secure information that will aid the farmers of that area and what questions must he answer to obtain that information? He has two main problems to solve: (1) The determination of the phosphorus status of the individual farmer's fields, and (2) the trial and testing of various phosphatic fertilizers in conjunction with determining the effect of management practices on nutrient requirements. An experimental procedure for answering the first question has been briefly indicated in the preceding section and has been fully discussed by Bray (7). An answer to the second question which utilizes the feracity concept will be described below.

The first requisite for the solution of the problem is a typical field known to be low in phosphorus supplying ability. If the field is deficient in other nutrients as well, sufficient amounts of the indicated fertilizers should be applied over the entire area. Soil samples of the various plots should be taken before any phosphatic fertilizers are applied. A crop rotation which is common in the area is selected, and if pos-

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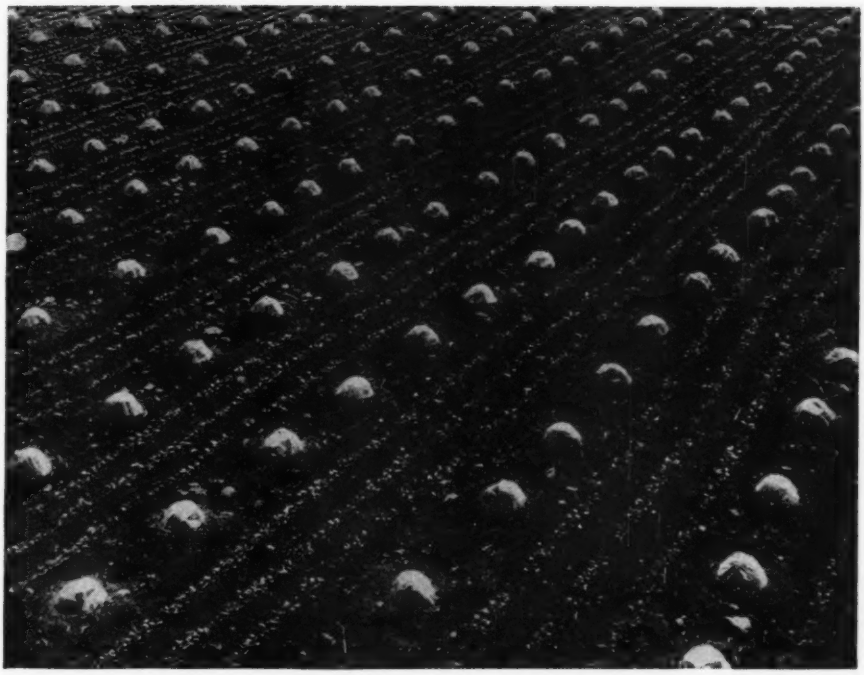
PICTORIAL

Momentous decisions often depend upon very small differences.

(Above) Many farm girls are doing war production work at home. This California girl plows an acre per hour with this equipment. (Below) Cultivating the Chase Gardens, near Eugene, Oregon. These gardens contain more than 100 acres and are devoted entirely to flowers.



(Above) Not a tented city, but a scene on a southwestern Pennsylvania truck farm where capped cantaloupes are interplanted with radishes. (Below) Top-dressing wheat with 150 pounds of 0-10-25 per acre and seeding sweet clover on the Monon Valley Farm, Monon, Indiana.

(Above) "Ummm . . . it sure smells good."—But let's hope there are no angry bees around.

(Below) Attractive farm home of Mr. and Mrs. W. N. Minor, Eatonton, Georgia.

The Editors Talk

Plant-food Tonnage Reports

Until very recent years it was generous to call figures relating to fertilizer usage and consumption in this country—"statistics." They mostly were figures selected on the basis of estimation, guesswork, and various expediencies pending on the ingenuity, resourcefulness, and enterprise of the compiler. It was almost impossible to get very definite figures even on total tonnage of fertilizer except in those States where tonnage tax tags were required. Now there are a great many States which compile figures on fertilizer usage which are very helpful. There is still a woeful lack of uniformity in the data and far too many cases where there are serious gaps in the data available.

Typical of the progress being made in fertilizer records are a number of releases on fertilizer figures in the list of reviews this month. Announcement FM-37 from California gives the tonnage of various fertilizer materials and mixed goods used in the last quarter of 1941 in California. This shows that less than one-third of all the tonnage was mixed goods, with nitrogen carriers making up most of the tonnage of the straight materials sold. Connecticut Agricultural Experiment Station Bulletin 453 gives figures on the fertilizer tonnage in that State for 1941. Over half the tonnage was mixed goods and of these mixed goods about three-quarters contained 20 or more units of plant food. In a mimeographed release by the State Chemist of Maryland, it is indicated that 128 analyses were registered for sale in that State in 1941 although 15 analyses accounted for nearly 80% of the total tonnage and nearly 60% of the tonnage consisted of analyses recommended by the Experiment Station.

A very complete analysis of fertilizer usage in Michigan has been prepared by the Soil Science Department of Michigan State College. In 1941 nearly 90% of the total consumption was in the form of mixed fertilizers of which over 97% contained 20 units or more of plant food. The percentage of total sales containing 20 units or more of plant food is high and this remarkably good record is of even greater significance when it is noted that only 72% of the tonnage contained 20 or more units of plant food in 1934. About 92% of all fertilizers were composed of grades or ratios recommended by the College and about 79% of the total sales were made up of 10 leading grades. Forty-nine grades of mixed goods are listed in addition to materials.

In New Jersey a mimeographed report of fertilizer sales in 1941 prepared by the Soils and Crops Department of the Experiment Station showed that around 90% of the total sales were in the form of mixed goods. About 40% of the mixed goods consisting of 19 different grades were in the ratios recommended by the Experiment Station. Nearly 90% of the total tonnage of mixed fertilizers consisted of the 23 leading grades, but there were 108 other grades sold in amounts of 1,000 tons or less.

These various compilations show that great progress has been made in increas-

ing the usage of fertilizers containing 20 units or more of plant food and in the usage of recommended grades or ratios. This is highly satisfactory in view of the urgency of use of high analysis fertilizers in this country's war effort. As has been pointed out in previous issues of this magazine, and again in this issue in the article by T. K. Wolfe, concentrated fertilizers not only mean savings in the cash, time, and labor of the consumer and producer, but saving in transportation space which is now in such great demand.

There is still much improvement to be made in the matter of reducing the number of grades on the market; in fact, it would look as though little progress was being made in the reduction of the total number of grades except where regulations prevent sale of more than a specified number of grades or ratios. Undoubtedly the trend to use of higher analysis fertilizers which is now under way will be speeded up, if not voluntarily, under Government pressure, and will have its effect on lessening the total number of grades. Thus another emergency will be added to the list of those out of which comes benefit to all concerned.

Conservation in an All-out

The role of soil conservation in an all-out war effort undoubtedly is puzzling many people. How can we conserve the fertility of our fields, the wealth of our forests, the power of our streams, and the natural bounty of our lands and still meet the huge production goals?

Hugh H. Bennett, Chief of the Soil Conservation Service, U. S. Department of Agriculture, gave the answer in a recent address before the Seventh Annual North American Wildlife Conference held in Toronto, Canada. Stating that there is no place in wartime for the conception of conservation as hoarding, scrimping, saving up, or putting aside for a rainy day, he briefly outlined six foundation blocks for a productive conservation: 1—Conservation of soil and water means greater yields from cropland, pasture, forest, and range; 2—Conservation means putting every acre of land to work on the production job it is best suited to perform; 3—Conservation means the elimination of waste in farming—the elimination of wasted soil, water, fertilizer, seed, or of any other element of productive capacity; 4—Conservation means increasing the area of arable land—by control of erosion, by drainage, irrigation, or other proved conservation practices; 5—Conservation means assurance that crops will be produced in spite of drought, rainstorms, wind, and snow—as far as it is possible to protect crops from unusual weather conditions; 6—Conservation means assurance that the agricultural plant will not break down in the middle of the war. Conservation is the only assurance that we will be able to produce at top speed, year in and year out, as long as our critical needs may last.

Dr. Bennett pointed out that the United States was in the last war only 19 months, but millions of acres of farm and ranch lands were so badly damaged as a result of the unwise way we used them then that they have not fully recovered yet. That was a mistake we cannot afford to repeat. Four or five years' abuse like that might seriously impair our farm plant. Every inch of topsoil washed or blown away now means decreased yields from now on. We can't afford to follow production methods that might get results this year at the risk of failure a year or so later. We've got to be ready to run our agricultural plant at full capacity—to produce more and more, and still more—year after year.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ A new edition of the fertilizer recommendations for Ontario has been issued by the Provincial Department of Agriculture. This is "Recommendations for Soil Management and Use of Fertilizers." It was prepared by the Advisory Fertilizer Board for Ontario, and is one of the best pamphlets of its type issued anywhere. Brief and concise but clear and practical information and advice on soil organic matter, lime, manure, soil testing, method of fertilizer application, and specific recommendations for various crops growing under different conditions are given. Field crops, fruits, vegetables, lawns, and specialty crops are included.

¶ A pamphlet of great practical use to farmers and farm advisers is Illinois Extension Service Mimeographed Pamphlet AG-1022, "Mixed Fertilizers and Practices Related to Their Use in Illinois," by A. L. Lang. This briefly covers what fertilizers are, describes the principal nitrogen, phosphorus, and potassium carriers, explains such terms as fertilizer grades and fertilizer ratio, gives the amounts of plant foods required to produce some important farm products, discusses the maintenance of the fertility of the soil by the use of lime, organic matter, and fertilizers, summarizes results obtained by the use of fertilizers on wheat, corn, and soybeans, on various experimental fields in the State, and makes suggestions on the use of fertilizers for corn, wheat, and legumes growing on different soils under various systems of management.

¶ An interesting series of papers was presented at a Fertilizer Conference held jointly by the Tennessee Experiment Station and fertilizer groups in that State last fall. These have been collected and issued by the Tennessee Extension Service as Mimeographed Pamphlet CL 9909. Among the papers was one by Director Mooers of the Experiment Station giving the general fertilizer requirements in the several agricultural regions of Tennessee, based on experiments and observations of the Experiment Station and Extension staffs. Phosphate is usually the first limiting element, and when this need is met potash also is usually needed. Nitrogen is deficient in these soils so that as a rule a complete fertilizer would appear to be needed. In the Central Basin the soil has better supplies of phosphate, but nitrogen usually is very deficient and potash is frequently deficient, especially on tobacco. Western Tennessee generally needs phosphate, potash, and nitrogen.

Dr. MacIntire showed that, contrary to a common belief, the use of lime does not increase the soluble potassium in the soil, but rather the opposite. Whenever lime was applied, potash in leached water and in the plants growing on the soil was decreased. This is not meant to imply that lime should not be used, but rather that when lime is used as needed appropriate potash fertilization should also be given. This was stressed by Dr. Winters in his paper on the subject of liming needs for Tennessee soil in relation to fertilizer usage. Dr. Washko showed that alfalfa yellows might be caused by five different fac-

tors; namely, potash deficiency, heat and drought injury, leafhopper injury, a disease due to micro-organisms, and boron deficiency. The latter apparently is becoming an increasingly troublesome factor in growing alfalfa in Tennessee, particularly on the second crop. The use of borax in appropriate amounts has been found to be very effective in preventing alfalfa yellows due to boron deficiency, but additional work is needed to learn the amounts and time and frequency of application needed for best results. Other papers dealing with fertilizer problems and farm management, the fertilizer supply situation as affected by war conditions, and ways of meeting these problems were presented.

¶ Much interest has been aroused among those growing specialty crops and plants and even among those interested primarily in field crops in the value of vitamins on plant growth. Many have felt that these vitamins had much the same effect as fertilizers and might be used as such. This has been investigated by G. S. Fraps and J. F. Fudge, who published their results as Circular 95 of the Texas Agricultural Experiment Station. This publication is entitled "Vitamin B_1 (Thiamin) and Other Vitamins as Fertilizers." They found that some flowers were benefited by the use of vitamins but many others and several vegetable crops were not benefited when growing under ordinary greenhouse conditions. They also found some indication that the use of thiamin helps the plant recover from the shock of transplanting. Little benefit from the other vitamins was found, and they would not replace fertilizers. The authors conclude from their work and from an extensive survey of literature that plants growing under ordinary conditions usually can produce all the vitamins they need.

"Commercial Fertilizer Sales as Reported to Date for the Quarter Ended December 31, 1941," St. Dept. of Agr., Sacramento, Calif., Anns. FM-37, Feb. 18, 1942.

"Recommendations for Soil Management and Use of Fertilizers," Ont. Dept. of Agr., Toronto, Ont., Canada, Jan. 1942.

"The Nitrogen Requirement of Sugar Beets," Agr. Exp. Sta., Fort Collins, Colo., Tech. Bul. 28, Feb. 1942, Robert Gardner and D. W. Robertson.

"Commercial Fertilizers, Report for 1941," Agr. Exp. Sta., New Haven, Conn., Bul. 453, Nov. 1941.

"Fertilizer, Seed, and Ice Cream Report, July-December 1941," St. Bd. of Agr., Dover, Del., Quarterly Bul., Vol. 31, No. 4.

"Mixed Fertilizers and Practices Related to Their Use in Illinois," Agr. Ext. Serv., Urbana, Ill., AG-1022, Feb. 20, 1942, A. L. Lang.

"Maryland Fertilizer Facts for 1941," Insp. and Reg. Serv., College Park, Md.

"Commercial Fertilizers, Feeds, and Agricultural Liming Materials," Insp. and Reg. Serv., College Park, Md., Control Ser. No. 181, Jan. 1942.

"Tonnage of Different Grades of Fertilizer Sold in Michigan, 1941," Mich. St. Col., East Lansing, Mich.

"Report of Fertilizer Sales in New Jersey for 1941," Agr. Exp. Sta., New Brunswick, N. J.

"Twelfth Annual Report of the New Mexico Feed and Fertilizer Control Office for Year Ending December 31, 1941," St. Feed and Fert. Control Off., State College, N. Mex., Feb. 1, 1942, R. W. Ludwick and Lewis T. Elliott.

"Proceedings of Fertilizer Conference, Nashville, October 21, 1941," Agr. Ext. Serv., Knoxville, Tenn., CL-9909, Jan. 3, 1942.

"Distribution of Fertilizer Sales in Texas for 1940-1941," Agr. Exp. Sta., College Station, Texas, Prog. Rpt. 759, A. D. Jackson.

"Vitamin B_1 (Thiamin) and Other Vitamins as Fertilizers," Agr. Exp. Sta., College Station, Texas, Cir. 95, Mar. 1942, G. S. Fraps and J. F. Fudge.

Soils

¶ A number of different methods have been devised for running relatively rapid chemical tests on soils in an effort to determine their fertilizer needs. One of the most widely used of these tests is the Universal Soil Testing System devised by Dr. M. F. Morgan. He has described this in detail in several bulletins. His latest publication is entitled "Chemical Soil Diagnosis by the Universal Soil Testing System," and is issued as Bulletin 450 of the Connecticut Agricultural Experiment Station at New Haven. This is the most complete bulletin issued on a soil-testing method and the subject is covered very thoroughly. Practically all of the quick-testing methods are briefly reviewed, and the method devised by Dr. Morgan is given in sufficient detail to enable

anyone with proper training and experience to use his testing system. Complete directions for the preparation of reagents and conducting the tests are included. Considerable attention is devoted to interpreting the results of the tests, which admittedly is the most difficult part of soil testing. Everyone interested in soil testing will find this bulletin of great value.

"Chemical Soil Diagnosis by the Universal Soil Testing System," Agr. Exp. Sta., New Haven, Conn., Bul. 450, Oct. 1941, M. F. Morgan.

"A Method for Determining the Lime Requirement of Georgia Soils," Agr. Exp. Sta., Experiment, Ga., Cir. 133, Feb. 1942, L. C. Olson.

"Bench Terracing by the Barrier Method," Agr. Ext. Serv., Honolulu, Hawaii, Cir. 126, Nov. 1941, Norman King.

"Soil Survey, the Sacramento-San Joaquin Delta Area, California," U. S. D. A., Washington, D. C., Ser. 1935, No. 21, July 1941, Stanley W. Cosby.

Crops

¶ Much importance is being attached to the growing of a sufficient volume of vegetables to meet the needs of ourselves and our Allies. While large scale commercial production will have to meet the needs of the canners and large buyers, it is felt that the situation can be greatly helped by having a number of small gardens to take care of the family needs of those who have the land available for this purpose. The aggregate productions of these gardens would be large, and the demands on the commercial growers who meet domestic needs would be correspondingly reduced, releasing more of their crops for war needs. In order to supply information for those who want to grow such gardens, the U. S. Department of Agriculture and many of the state experiment stations or agricultural extension services have issued bulletins and pamphlets on home gardens. These will be found listed below.

In most cases suggestions are given on the kinds of vegetables to grow, the quantities that will be needed to supply the average family needs, the amounts that should be planted to supply these needs, how to lay out the garden, the preparation and fertilization of the soil, varieties, planting methods including time and rate of seeding, and in some cases disease and insect control. The consulting and use of these bulletins will save much disappointment by many amateur gardeners and will aid in the efficient utilization of our seed and fertilizer resources, which are just about ample to go around and cannot be wasted.

¶ Within the last several years there has been increasing attention paid to the growing of small grains in the South. It has been found that these crops are well suited to Southern agriculture and climate and produce comparatively good yields of feed either as grain or as hay. They are also very efficient winter cover crops. Information on growing oats, wheat, rye, and barley is presented by E. D. Alexander in Georgia Agricultural Extension Service Bulletin 486, "Small Grains in Georgia." Time and rate of seeding, varieties, fertilization, harvesting, and utilization of each of these crops are briefly discussed. A complete fertilizer at planting time with nitrogen or nitrogen-potash top-dresser in the spring is suggested for these crops except when they are planted on soil that has received heavy applications of phosphate and potash for the preceding crop, in which case a nitrogen top-dressing in the spring will be sufficient.

"Fifty-first Annual Report, January 1 to December 31, 1940," Agr. Exp. Sta., Auburn, Ala.

"Utilization of California Fruits," Agr. Exp. Sta., Berkeley, Calif., Cir. 349, Oct. 1941, W. V. Cruess and G. L. Marsh.

"Methods and Equipment for the Sun-drying of Fruits," Agr. Exp. Sta., Berkeley, Calif., Cir. 350, Nov. 1941, E. M. Mrak and J. D. Long.

"Sweet Corn Hybrids Lexington, Lincoln, and Lee," Agr. Exp. Sta., New Haven, Conn., Cir. 148, Oct. 1941, W. R. Singleton and D. F. Jones.

"Herbs and Their Culture," Agr. Exp. Sta., New Haven, Conn., Cir. 149, Nov. 1941, Ruth M. Hendrickson and Frances M. Johnson.

"Florida Farmers and Food for Freedom," Agr. Ext. Serv., Gainesville, Fla., Cir. 60, Jan. 1942, J. Francis Cooper.

"Research and Investigational Activities—Annual Report for the Fiscal Year Ending June 30, 1941," Col. of Agr., Athens, Ga., Univ. Bul., Vol. XLI, No. 26, June 30, 1941.

"Small Grains in Georgia," Agr. Ext. Serv., Athens, Ga., Bul. 486, Oct. 1941, E. D. Alexander.

"Dahlia Variety Test, 1941," Agr. Exp. Sta., Experiment, Ga., Cir. 132, Dec. 1941, H. L. Cochran, David D. Long, W. D. Ricks, and T. L. Bissell.

"Cotton Variety Experiments in Georgia, 1937-1941," Agr. Exp. Sta., Experiment, Ga., Cir. 134, Feb. 1942, R. P. Bledsoe and U. R. Gore.

"Culture of Tomatoes," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 119, Sept. 1941, Ashley C. Browne, L. A. Dean, and W. A. Frazier.

"Increasing the Germination of Koa Haole Seed," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 122, Oct. 1941, J. C. Ripperton.

"Home Garden Questions and Answers," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 123, Sept. 1941, L. A. Dean, W. A. Frazier, F. G. Holdaway, F. Okumura, and A. C. Browne.

"Harvesting, Packing, and Marketing Tomatoes," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 125, Oct. 1941, W. W. Jones and Kenneth I. Hanson.

"Head Cabbage in the Home Garden," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 131, Fuyuki Okumura.

"Eggplant—(Round) in the Home Garden," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 132, Dec. 1941, Fuyuki Okumura.

"Tomatoes in the Home Garden," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 133, Dec. 1941, Fuyuki Okumura.

"An Illinois Garden Guide," Agr. Ext. Serv., Urbana, Ill., Cir. 522, Feb. 1942, B. L. Weaver and L. A. Somers.

"Iowa Corn Yield Test, 1941," Agr. Exp. Sta., Ames, Iowa, Bul. P38, Feb. 1942, Joe L. Robinson and Marcus S. Zuber.

"A Preliminary Report of Certain Variety, Fertilizer, and Other Tests Conducted by the Crops and Soils Department of the Louisiana Experiment Station—1941," Agr. Exp. Sta., University Station, Baton Rouge, La.

"Spelt in Michigan," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 180, Feb. 1942, H. M. Brown.

"Factors Which Make for Success in Orcharding," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 181, Jan. 1942, H. P. Gaston.

"Forty-eighth Annual Report, July 1, 1940 to June 30, 1941," Agr. Exp. Sta., University Farm, St. Paul, Minn.

"Crop Rotation Studies," Agr. Exp. Sta., University Farm, St. Paul, Minn., Tech. Bul. 149, Dec. 1941, H. Y. Chen and A. C. Arny.

"Garden for Victory," Agr. Ext. Serv., University Farm, St. Paul, Minn., Pamp. 91, Feb. 1942.

"Grow Greens for Health," Agr. Ext. Serv., University Farm, St. Paul, Minn., Pamp. 92, Feb. 1942.

"Soybeans for Grain," Agr. Ext. Serv., State College, Miss., Leaf. 20, Feb. 1942, J. M. Weeks.

"Peanuts," Agr. Ext. Serv., State College, Miss., Leaf. 21, Feb. 1942, J. M. Weeks.

"Commercial Strawberry Culture in Missouri," Agr. Exp. Sta., Columbia, Mo., Cir. 216, Dec. 1941, T. J. Talbert and A. D. Hibbard.

"Soybeans for Grain," Agr. Ext. Serv., Columbia, Mo., Cir. 450, Feb. 1942, J. R. Paulling.

"Representative Missouri Weeds and Their Control," Agr. Exp. Sta., Columbia, Mo., Bul. 433, Aug. 1941, W. B. Drew and C. A. Helm.

"The Montana Farm Garden," Agr. Ext. Serv., Bozeman, Mont., Bul. 196, June 1941, E. E. Isaac.

"Ornamental Trees and Shrubs for New Mexico," Agr. Exp. Sta., State College, N. Mex., Bul. 284, Oct. 1941, J. V. Enzie.

"Controlling the Pre-harvest Drop of Apples," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 766, July 1941, M. B. Hoffman.

"The Winter Hardiness of Some Ornamental Woody Plants of New York State," Cornell Univ., Agr. Exp. Sta., Bul. 772, John F. Cornman.

"The Relation of Spacing to Yield and to Plant and Ear Development of Some Yellow Sweet Corn Hybrids in New York," Agr. Exp. Sta., Geneva, N. Y., Bul. 700, Feb. 1942, W. D. Enzie.

"Methods of Growing Strawberries and Bramble Fruits," Agr. Ext. Serv., Stillwater, Okla., Cir. 133, Rev. 1941, D. C. Mooring and G. F. Gray.

"Home Vegetable Garden," Agr. Ext. Serv., Stillwater, Okla., Cir. 196, Rev. 1941, D. C. Mooring.

"Corn in Oklahoma," Agr. Ext. Serv., Stillwater, Okla., Cir. 324, Rev. 1941, Luther H. Brannon.

"Extension—Its Aims and Accomplishments. Twenty-seventh Annual Report of the Extension Division, 1940," Agr. Ext. Serv., Stillwater, Okla.

"Influence of Spacing on Yield and Grade of Strawberries," Agr. Exp. Sta., Kingston, R. I., Bul. 283, Nov. 1941, E. P. Christopher.

"Grow Winter Cover Crops," Agr. Ext. Serv., Knoxville, Tenn., Leaf. 6, Sept. 1941.

"Green Shell Soybeans as Garden Crops," Agr. Ext. Serv., Knoxville, Tenn., Sp. Cir. 153, Oct. 1941, W. C. Pelton and Maude Guthrie.

"Apple Varieties and Important Producing Sections of the United States," U. S. D. A., Washington, D. C., Farmers' Bul. 1883, Nov. 1941, J. R. Magness.

"Birdsfoot Trefoil and Big Trefoil," U. S. D. A., Washington, D. C., Cir. 625, Nov. 1941, Roland McKee and H. A. Schoth.

"The Anatomy of the Seedling and Roots

of the Valencia Orange," U. S. D. A., Washington, D. C., Tech. Bul. 786, Jan. 1942, H. E. Hayward and E. M. Long.

"Victory Gardens," U. S. D. A., Washington, D. C., Misc. Pub. 483, Feb. 1942, Victor R. Boswell.

"Peanut Oil and the War," U. S. D. A., Washington, D. C., BAE-Ext. Flier 3.

"The Fruit Industry of Argentina," U. S. D. A., Washington, D. C., Foreign Agr. Rpt. 1, Jan. 1942, Fred A. Motz.

"The Fruit Industry of Brazil," U. S. D. A., Washington, D. C., Foreign Agr. Rpt. 2, Jan. 1942, Fred A. Motz.

"The Fruit Industry of Chile," U. S. D. A., Washington, D. C., Foreign Agr. Rpt. 3, Jan. 1942, Fred A. Motz.

Economics

¶ The Georgia Experiment Station, in cooperation with the Bureau of Agricultural Economics of the U. S. Department of Agriculture, has published a very timely circular, No. 135, entitled "Producing Peanuts for War Needs (Sumter County, Georgia)," by James C. Downing, Robert Terry, and W. E. Hendrix.

As a part of the war program farmers have been asked to plant 5 million acres of peanuts, about 2½ times the 1941 planting. Considerable reorganization in the peanut-producing areas must be made if the goal is attained. The fact that Georgia is one of the most important peanut-producing states and that Sumter County is one of the leading peanut-producing counties in the State makes this study especially interesting and timely.

The reason for this tremendous increase in peanut production, primarily for oil, is due to the closing of shipping lanes from about one-half of our sources of imported fats and oil. Peanut oil is used for food purposes such as shortenings and oleomargarines, and in addition large quantities are used in soaps, pharmaceuticals, glycerine, lubricants, putty, and paints. With the war requiring the production of so many substitutes and increases in the production of most oil products, peanut oil will undoubtedly become a major raw material for the chemical industry.

With respect to the income from peanuts, it is calculated that under average Sumter County conditions, peanuts harvested for oil will return about $20.50 per acre above cash expenses. This return per acre is less than that for cotton and edible peanuts, but is greater than the returns from "hogging off" peanuts or growing corn. However, on a labor basis the returns from hogging off, edible peanuts, and cotton are all higher than peanuts grown for oil.

It is emphasized further that low peanut yields will always result in relatively small returns per acre. This fact demonstrates clearly the desirability of using good seed, getting operations done at the proper time, fertilization, and other practices affecting the quantity produced.

With respect to fertilizers, it is pointed out that on very fertile soils or soils that have been heavily fertilized in the past, increases in yields from fertilizer application are relatively small. However, in most instances on land that will not produce 1,000 pounds of peanuts per acre, it will pay to fertilize. Much of the peanut increase is expected to be planted on land that had little or no fertilizer applied to it in 1941. Consequently, an application of 200 to 300 pounds per acre of 3-8-8 on Spanish or 0-8-8 on Bunch or Runners before planting is recommended as a means of insuring maintenance of soil fertility, a good yield, a good money return, and a maximum contribution toward the war effort.

The bulletin sets up five alternative farm plans for reorganizing medium-sized cotton-peanut farms to meet war needs and discusses them from the standpoint of the labor requirement, cash income, and soil fertility. Each of the plans seems to have its advantages and disadvantages and would have to be considered from the standpoint of the organization and available labor on the individual farm.

The authors state that large increases in the acreage of crops are often accompanied by lower average yields because of scarcity of the adaptable land. If this same principle holds true for peanuts, present rates of yield may not

be maintained except at higher costs for fertilizer. It generally will be best to use the idle land for feed crops, thereby releasing other parts of the cropland for the peanut acreage increases. Farms that do not have idle cropland will find it necessary to replace some corn, cotton, and miscellaneous crops, if they are to help meet the peanut goal.

It is concluded that all of the plans outlined in the pamphlet drain soil fertility heavily. This situation makes it imperative that more winter cover crops be planted and turned and more fertilizer used during the war emergency than has been the usual practice in this area. When the war is over, and prices have returned to normal, farmers should immediately begin to follow a more soil-conserving program than is consistent with meeting the necessary war needs in 1942.

"Systems of Farming for the Central Bluegrass Region of Kentucky," Agr. Exp. Sta., Lexington, Ky., Bul. 419, June 1941, W. D. Nicholls, George B. Byers, and John H. Bondurant.

"The Transmission of Farming as an Occupation," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 768, Oct. 1941, W. A. Anderson.

"Agricultural Production in New York, 1866 to 1940," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 769, Oct. 1941, T. E. LaMont.

"Changes in the Prices of Apples and Other Fruits," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 773, Dec. 1941, M. D. Woodin.

"Farm Management in Newberry County, South Carolina," Agr. Exp. Sta., Clemson, S. C., Bul. 338, Jan. 1942, M. J. Peterson and J. D. Kinard.

"Cost and Profit of Ginning Cotton in Texas," Agr. Exp. Sta., College Station, Texas, Bul. 606, Jan. 1942, W. E. Paulson.

"Bibliography on the Agriculture of the American Indians," U. S. D. A., Washington, D. C., Misc. Pub. 447, Jan. 1942, Everett E. Edwards and Wayne D. Rasmussen.

"A Method of Estimating the Economic Effects of Planned Conservation on an Individual Farm," U. S. D. A., Washington, D. C., Misc. Pub. 463, Jan. 1942, Arthur C. Bunce and George W. Collier.

"Report of the Chief of the Agricultural Marketing Service, 1941," U. S. D. A., Washington, D. C.

"Report of the Chief of the Commodity Exchange Administration, 1941," U. S. D. A., Washington, D. C.

"Report of the Chief of the Bureau of Agricultural Economics, 1941," U. S. D. A., Washington, D. C.

"Improving Low Incomes on Tobacco Farms, Caswell County, North Carolina, U. S. D. A., Washington, D. C., FM-24, June 1941, Robert E. Graham, Jr.

"Summaries from Farm-business Analysis Studies in the United States, 1907-39," U. S. D. A., Washington, D. C., FM-26, Dec. 1941, H. W. Hawthorne.

"Uses for Cotton," U. S. D. A., Washington, D. C., Agr. Ec. Bib. N 91, Sup. 44, Feb. 1941, Dorothy M. Ellis.

"War and Agriculture in the United States, 1914-1941," U. S. D. A., Washington, D. C. Agr. Ec. Bib. 93, Jan. 1942, Walter T. Borg.

Fewer and Higher Fertilizer Grades

(*From page* 19)

tions, they have not gotten very far in doing much about it, except through certain organizations.

Sand and other worthless fillers are expensive at any time. But in wartime, of all times, it is exceedingly important to conserve the great amount of shipping space that useless fillers in low analyses consume. A. L. Mehring in his article, "Higher Analysis Fertilizers as Related to the Victory Program," published in the January 1942 issue of BETTER CROPS WITH PLANT FOOD, says: "It requires the equivalent of 20,000 box cars moving 100 miles to haul the half million tons of unnecessary filler in mixed fertilizers."

Now is the time for fertilizer manufacturers to take bold and courageous action to eliminate the multiplicity of analyses, particularly the low analyses such as 0-10-4, 2-8-4, and others high in filler and costly on the basis of plant food. It is time to move aggressively to higher analyses. Such steps are in the interest of the farmer, the manufacturer, and the Nation.

The Production and Use of Potash in America

(*From page* 14)

sections of Europe for similar purposes. As early as 1810, the value of the exported potash had reached a figure of more than one and one-half million dollars. This industry died when the forests dwindled and potash began to be imported from Europe.

It was not until 1840 when Justis von Liebig reported that plants through their roots fed upon minerals in the soil that potash was recognized as an important plant nutrient. Liebig disclosed that potash is one of the principal constituents in the ash of all plants and emphasized the fact that since plants use such large amounts, soils should be well supplied with potash. At about the same time the large deposits of potash in Stassfurt, Germany, were discovered while drilling for salt, and in 1860 the first plant for the processing of these crude salts was built. The development of this industry gave Germany almost a monopoly on potash until the first World War.

American Potash Production

During that war, the scarcity of potash in America and the prices which had skyrocketed for any that could be obtained led to attempts to recover the element from all possible sources. These included industrial wastes from the cement, iron, beet sugar, alcohol, tobacco, hardwood, and wool industries and from kelp and brines. More than 70 plants sprang up, producing potash at high cost but still meeting only a small fraction of the demand. Following the armistice and the reimportation of potash from Europe, all but three of these domestic producers were forced to close for economic reasons. These three included the production of potash from brine and the small amounts recovered from the wastes of the cement and alcohol industries.

The one American producer of any volume to survive was the plant at Searles Lake, California, where potash is being extracted from the brine of a dried-up salt lake, with side products of borax and other industrial chemicals. However, the search for deposits in the United States which had begun during the war continued, and in 1926 the Government appropriated enough money for exploring areas in Texas and New Mexico. There, in what is known as the Permian Basin, rich beds of potash salts were discovered lying at a depth of about 1,000 feet underground. Subsequently a company was formed for the mining of these salts, and in 1931 another company was formed. The third important producer in this area began the marketing of its products late in 1940.

At the Searles Lake plant, brine is pumped from wells drilled in the crystal body of the lake. This brine is piped into evaporators where the potash is separated from other constituents. A high-grade muriate of potash is produced, most of which is used as such in the fertilizer and chemical industries. Some of this may be treated with sodium sulphate to produce sulphate of potash.

In the New Mexico plants, the crude ore, which resembles rock salt, is mined and crushed. Some of this is used directly for fertilizer under the name of manure salts. These consist of muriate of potash with sodium chloride and other impurities present. However, most of the raw salts are sent to the refineries where the impurities are removed, producing high-grade muriate of potash for fertilizer and chemical use. Some of the muriate is treated with sulphuric acid to make sulphate of potash with hydrochloric acid as a by-product.

At one of the mines a natural deposit of potash and magnesium sulphates, called langbeinite, occurs. This is ground and used as such after treatment

to remove some of the impurities, or it is treated with potassium chloride to produce straight sulphate of potash with magnesium chloride as a by-product.

The potash salts commonly occurring on the fertilizer market are:

Muriate of potash, containing 80-99% potassium chloride, equivalent to 50-62½% K_2O.

Sulphate of potash, containing 90-96% potassium sulphate, equivalent to 48-52% K_2O.

Manure salts, containing 22-26% K_2O in the form of muriate of potash.

Sulphate of potash-magnesia, containing 22-26% K_2O in the form of sulphate of potash and 10-18% magnesium oxide in the form of magnesium sulphate.

By far the greatest part of the potash used in agriculture is in the form of high-grade muriate since this is the cheapest per pound of plant food and is satisfactory for nearly all conditions. The manure salts may be more economical at points where shipping costs per pound of potash contained do not make them more expensive than the muriate form. Sulphate of potash, since it is a manufactured product, costs more per pound of plant food than muriate and its use is therefore restricted to those crop or soil conditions where a high chloride content in the fertilizer is not desirable. Sulphate of potash-magnesia is used where the sulphate form of potash is desired and where magnesium also is needed.

The production at all of these plants has been constantly increased, and now when European sources are again cut off and America's need for potash has increased from a recorded importation of 1,400 tons of potash salts in 1871 to an estimated consumption of well over 1,000,000 tons in 1941, this relatively new American industry is proving itself equal to the demands being placed upon it.

Modern Fruit Production

(*From page* 17)

subjects are modern in concept. The application of nitrogen in the fall is another comparatively new practice covered in the book.

The authors have presented their subject matter in a clear and interesting manner. They have quoted many references, which are conveniently listed at the end of each chapter. "Modern Fruit Production" will be of use and value to practical growers and their advisers as well as to students, since along with fundamental information, sufficient detailed material is given to make the volume a good handbook as well as reference.—*J. D. Romaine.*

Fertilizing Peanuts in Georgia

(*From page* 8)

Spacings of 24- to 30-inch rows and 4 to 6 inches in the row for Spanish and 30- to 36-inch rows and 8 to 12 inches in the row for North Carolina Runners have given best yields at the Experiment Station at Tifton. For these spacings, it will require 30 to 40 pounds of shelled or 65 to 80 pounds of unshelled seed for Spanish and 20 to 25 pounds of shelled seed for North Carolina Runners.

Peanuts should be cultivated frequently from the time the plants begin to come up until they cover a good portion of the ground. First cultivations are usually given with the weeder or spiketooth harrow. These imple-

Land may become infertile unless peanuts are grown in long rotations with soil improvement and other crops well fertilized.

ments can be used until the plants begin to be injured or the pegs commence to form. Small plows or sweeps are recommended for later cultivations. One- or two-horse cultivators with small plows and sweeps are excellent for this work. Vines must not be disturbed after pegs begin to form and only the middles should be cultivated after pods or nuts start forming.

A great deal of trouble, Mr. Alexander points out, is experienced in getting stands of peanuts due to the seed decaying in the soil before or at the time of germination. This trouble is caused by seed- or soil-borne diseases that appear to be controlled by seed treatment with 3 ounces of 2 per cent Ceresan for each 100 pounds of shelled or unshelled seed. From increases reported by the Georgia Experiment Station, seed treatment is practical.

Peanuts are ready to dig when the foliage begins to show a general yellowish maturity color, the nuts are well formed, and the inside of the shells begins to color and show darkened veins. If harvested too early, the kernels will shrink, curing will be more difficult, and the quality of the nuts will be greatly reduced. If harvested too late, leaves will be lost, and in the case of the Spanish variety kernels will be lost by sprouting, and nuts of both Spanish and North Carolina Runners will be pulled off and left in the soil. Vines should be well stacked and should remain in the stack until the nuts are

Approximate Amounts of Plant-food Elements in a Crop of Peanuts
(1,000 Pounds of Nuts and 2,000 Pounds of Hay)

Portion of crop	Yield per acre, lbs.	Nitrogen, lbs.	Phosphoric acid, lbs.	Potash, lbs.	Lime, lbs.
Peanuts	1,000	40.5	8.0	5.6	1.0
Hay	2,000	30.4	5.0	32.0	30.0
Total	3,000	70.9	13.0	37.6	31.0

thoroughly cured, usually from four to six weeks before the nuts are picked.

Machines used for picking should do a thorough job of removing the nuts from the vines, break as few nuts as possible, and clean the nuts of soil and trash. For best quality hay, peanuts should be harvested as soon as the nuts are ready, the vines should be stacked for best protection against rain, and picked and baled with as little loss of leaves as possible.

When the entire plant is removed from the land, as is done when peanuts are harvested for nuts, the fertility of the soil is rapidly depleted, provided proper rotations are not used to restore it. On the other hand, hogged-off peanuts are one of the best soil-improvement practices known, according to Mr. Alexander.

As with other crops in Georgia, it has been found that peanuts make best yields in soils with good amounts of nitrogenous organic matter and minerals. For best yields, for protection of the soil, and for control of disease, peanuts should not be planted on the same land more often than once in three or four years. Crops such as cotton, tobacco, possibly the small grains, winter legumes, and lespedeza are to be fertilized with good amounts of fertilizer as recommended for them.

Boron Stopped Fruit Cracking

(*From page* 9)

Another interesting result of the tests with boron is that the vitamin A content of alfalfa leaves has been increased as much as 30 per cent. This is, of course, connected with the enhanced green color of second and third crops where the boron is used on soils deficient in this element. Other stations have found similar results with respect to other vitamins.

In tests at the Oregon station it appears that old, leachy or peaty soils or those derived from igneous rocks are most likely to be deficient in boron. The soil reaction or lime and moisture content and temperature may affect the availability of boron in the soil, it was found. The boron treatment has carried over at least for two or three years and sometimes longer.

Mississippi Studies Cotton Fertilizer

(*From page* 16)

Rust was less noticeable on all of the plots in 1940 than in any preceding year. The plots receiving no fertilizer and 4-8-0 showed the greatest amounts. In 1937, 1938, and 1939, when it was dry in the summer and fall, the plots with increasing amounts of potash showed very marked differences in the prevalence of rust. The plots with no fertilizer and 4-8-0 lost most of their leaves as a result of rust before the bolls were mature thus resulting in low yields. As the percentage of potash increased, there was a decrease in rust, the plants remained green for a longer period and were larger, the bolls matured better, and the top bolls were larger. The excessive need for potash on this particular tract may be due to the large plant food removal by the crops grown previously. This test clearly shows the need for potash on soils where rust is prevalent.

The five years' average results, together with the yearly yields for each fertilizer treatment, are shown in Table 1. It is interesting to note that the yield on practically every plot in-

creased from year to year during the first three years. Some of this increase was probably a result of growing the winter peas and applying the basic slag. The increase in yield on the no-fertilizer plot indicates that this may be the case. However, the accumulative effect of the plant food on the fertilized plots may have some influence on the yearly increases in yield.

The results of this test indicate a need for increased application of potash where rust is prevalent and that the use of winter legumes and basic slag each year should reduce the need for heavy application of nitrogen and phosphorus fertilizers. It should be kept in mind that this test was conducted on a grey, silty upland soil, somewhat cold in nature.

Nutrient Availability—An Analysis

(*From page* 22)

sible another rotation which illustrates the best practices should also be included.

Let us further assume that two different forms of phosphatic fertilizers are being compared and that the time and manner of application are to be similar with both. Different amounts of each fertilizer are added to the individual plots, the crops grown, yields taken, and analyses made for their total phosphorus content. On the basis of such an experiment one might obtain average results like the following:

Fertilizer A

Phosphate added lb. per A.	Yield bu. per A.
0	30
50	45
100	55
200	70
300	80
500	90
1,000	100
1,500	100

Fertilizer B

0	30
100	35
300	40
600	45
1,000	50
2,000	55
3,000	55

Each fertilizer has increased phosphorus feracity and hetoemia on this soil, but to different degrees. When the fertilizers are compared at equal phosphorus feracities, it is found that at the 45-bushel level fertilizer A was 12 times as efficient as fertilizer B in that only one-twelfth as much was needed. At the 55-bushel level, however, its relative efficiency has increased to 20 times that of fertilizer B. If fertilizer A is more expensive than B, a farmer who operates at the 45-bushel level might find it more economical to use B. But due to the much greater relative efficiency at the 55-100-bushel level of fertilizer A, a farmer might find it more economical to buy A. In the 60- to 100-bushel levels, of course, no relative comparisons between A and B are possible. Experiments of this type thus readily lend themselves to practical applications. A knowledge of the relative efficiencies of fertilizers on various soils makes possible other calculations involving the costs of the fertilizers, and a farmer can determine the most economical source of nutrients at whatever fertility level he chooses.

This method of evaluating fertilizer efficiencies at equal feracities is not restricted to a comparison of different fertilizers. It is also applicable to different methods of application of the same fertilizer such as a broadcast—drilled—hill-drop comparison. In such an experiment, different rates should

be tested with each method of application. The amount of fertilizer for each method which results in equal feracities can then be used in a direct calculation of placement efficiency.

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Permanent Hay—the Plant Food Way

(*From page* 12)

of fall vs. spring use of fertilizers, one series of plots was fertilized in the early spring, about April 15 to May 1, and an adjacent series in the late fall, about November 1 to 10.

Very simple fertilizer treatments were made on each field, comparing nitrogen alone in the form of cyanamid at 300 pounds per acre with a complete fertilizer containing its nitrogen as cyanamid at the above rate and superphosphate and potash to make a 1-1-1 ratio of plant food. In simple terms, the complete fertilizer was approximately equal to 600 pounds per acre of a 10-10-10 fertilizer. Untreated check plots in duplicate were maintained for comparison.

Yields for two cuttings of hay were obtained each year and observations recorded. Since trends were found much the same on all fields, the average data for the five experiments will be presented here for sake of simplicity.

Results Outstanding

Results obtained from the use of the complete fertilizer (Table 1) much exceeded expectations. It gave outstanding increases in the yields of hay the first year of application and progressive increases throughout the 4-year period of the experiment. Year by year the appearance of the stand also continued to improve until an average of more than 1½ tons of extra hay per acre per year was being obtained on all fields over and above the untreated check plots (Figs. 1 and 2).

Not only did timothy stool and make a marked comeback with the complete fertilizer; but clovers, including red, alsike, and white, also volunteered. In fact, the stands looked so good that farmers seeing them wished to try the treatment on their own fields. They would not want to plow under such a good looking and prolific stand of hay. It appeared that the hay could be maintained permanently without plowing and reseeding by means of a complete fertilizer at the rates employed. The complete fertilizer performed well on all five fields whether the soil was clay, loam, or sand. From these experiments it was very evident that a sufficiency of plant food would maintain hay in a permanent productive condition, and that the reason why hay stands "run out" is because they exhaust the available plant food.

However outstanding the result from its use, it still seemed possible from the appearance of certain of the plots that the complete fertilizer was not used in the most economical rate or in the most economical ratio on each particular soil. Therefore, experiments have been recently established to determine the best fertilizer rates and ratios for permanent hay on different soils, but sufficient time has not elapsed to obtain these data.

Farmers often have time to apply

TABLE I.—THE EFFECT OF NITROGEN ALONE VS. COMPLETE FERTILIZER ON YIELDS OF HAY FROM FIVE FIELDS.

	Average increase over check, dry weight basis (lbs.)				
	1937	1938	1939	1940	Total
Nitrogen alone	711	1,059	1,010	1,158	3,938
Complete fertilizer	2,075	2,394	2,963	3,448	10,880

fertilizer in the fall, whereas they are apt to be rushed in the spring. If complete fertilizer were just as effective when applied in the fall as in the spring, the former would be a good time to apply it. Therefore, early spring (April 15 to May 1) and late fall (November 1 to 10) applications of complete fertilizers were compared to see if they were equally effective for the growth of hay. Here again resulting trends in yields for the five fields, with one exception, were much alike.

Average data are shown in Table 2.

TABLE 2.—EARLY SPRING VS. LATE FALL APPLICATION OF COMPLETE FERTILIZERS ON THE YIELDS OF HAY FROM FIVE FIELDS.

	Average increase over untreated check, dry weight basis (lbs.)				
	1937	1938	1939	1940	Total
Early spring application	2,075	2,394	2,963	3,448	10,880
Late fall application	2,049	1,885	2,355	3,067	9,356

Over the 4-year period the early spring application of complete fertilizer was better than a late fall application of the same fertilizer. Observations also confirmed these data.

Although the difference was not great the first year, it was noticeable thereafter. The fall application of complete fertilizer was inferior probably because its nitrogen leached or washed away and thus became partly ineffective during the winter. Cal-Nitro (nitrate), a more easily leached form of nitrogen than cyanamid, was also included among the fertilizers used as a possible check on the validity of such an idea. If fall applications of cyanamid-containing fertilizers were inferior to spring applications by reason of leaching, Cal-Nitro fertilizer should be still more inferior because of greater leaching. Results obtained in this connection are shown in Table 3.

Both cyanamid and Cal-Nitro yielded much less when used in late fall than in early spring, Cal-Nitro particularly so. This indicated that leaching and washoff of nitrogen did occur and were probably the cause of the inferior effect of fall applications. Although fertilizer is not supposed to move laterally very much, vegetation on some plots indicated that fertilizer applied on rolling land in the late fall had moved several feet out of bounds. Washoff of fertilizer applied in the late fall may be more of a factor than is usually considered, especially if the surface soil freezes before the fertilizer leaches into it. It now seems possible that the fall application was made later than it should have been for most efficient use, but previous to the experiment it had been recommended that the fall application should be made after active plant growth ceased.

In general, under Vermont conditions it may be concluded that an early spring application of ready-mixed commercial fertilizers on hayland will give better results than a late fall application. It is not known what the effect of the fertilizer might have been had it been applied on the sod at other times during the growing season.

If ingredients of a complete fertilizer are purchased and applied separately, the nitrogen should be applied in the spring. It would seem that superphosphate and potash might be applied either in the fall or spring although no experiments have been conducted to show this. While extra penetration from fall fertilizer application may appear desirable, extra contact and con-

TABLE 3.—LATE FALL VS. EARLY SPRING APPLICATION OF CYANAMID AND CAL-NITRO UPON HAY YIELDS, AVERAGE OF ALL DATA.

	Yields per acre, dry weight basis (lbs.)		
	Fall application	Spring application	Difference in favor of spring
Cyanamid nitrogen	1,318	2,027	709
Cal-Nitro nitrogen	1,099	2,367	1,268

sequent soil fixation of plant food in unavailable form probably offset this advantage.

At the outset of these experiments it was thought that nitrogen alone on ordinary grass hayfields would be sufficient to prolong the productive life of hay for a year or two. However, the results obtained on all five fields indicated that nitrogen alone would not suffice. Fertility being at the customary farm level, nitrogen at a liberal rate of application increased the hay yield less than 900 pounds the first year, and not over 1,200 pounds thereafter, without visibly improving quality. At 1939 prices, this increase in yield from nitrogen alone was obtained at a fertilizer cost of about $14 per ton of hay, which is considerably more than one can afford.

Nitrogen alone gave little trend toward improvement in yield, whereas complete fertilizer gave a marked trend. With nitrogen alone grasses, like timothy, blue, and orchard, were stimulated only to a small extent; and new hay species were absent. This was in marked contrast to the accomplishments of the complete fertilizer which stimulated and propagated clovers and hay grasses.

On hayfields in the usual state of fertility, phosphates and potash are so badly needed that nitrogen alone could not be recommended even for one year. Only where phosphate and potash have been recently and generously applied could the use of nitrogen alone on hay be justified. At 1939 prices for the complete fertilizer used on all farms, the hay was produced at an average fertilizer cost of less than $7 per ton of hay. Under ordinary circumstances this complete fertilizer would pay if the hay was needed and had to be bought. Furthermore, there is undoubtedly considerable residual fertility not yet used by the plants. It is very likely that the fertilizer cost per ton of hay can be reduced without impairing quality when results of present research work on fertilizer rates and ratios are available.

Reinforcing Manure

For maintaining permanent hay, manure is a valuable plant food deserving more attention than it often receives and special attention this year when fertilizer supplies, especially nitrogen, are short. One ton of ordinary farm manure is equal to approximately 100 pounds of 10-5-10 commercial fertilizer. In practice such value is seldom attained because an appreciable fraction of the nitrogen in the manure is lost into the air as ammonia before it can be used by plants. This is especially true of manure top-dressed on hayland where it is subject to drying and freezing, which expel the ammonia. Furthermore, on the phosphate-hungry soils prevalent in this region, manure is much poorer in phosphate than it should be for maintaining permanent hay.

Several practical ways have been found to increase the crop-producing value of manure. Each has a place in

the fertilization of permanent hay.

Single strength 20% superphosphate at the rate of two pounds per cow per day or its equivalent can be spread evenly in the clean barn gutter to strengthen the "weak phosphate link" in manure and save some ammonia that would otherwise escape into the air in storage and in handling. Also, in this way the value (availability) of the superphosphate has been markedly increased on a number of soils. No fertilizer chemical has been found that can save all of the ammonia in manure. Superphosphate is as effective as any known at present.

On the same weight basis, 20% superphosphate is more effective than triple strength in retaining ammonia because of the gypsum, which the former contains and the latter does not. It has been found that gypsum, together with phosphates, has power to react with and retain some ammonia under conditions prevailing in manure.

Either granular or pulverized forms may be used on hay by way of the gutter. The choice depends on individual preference. Pulverized, coming in better contact with manure, retains more ammonia than granular, but this advantage may be practically offset because the pulverized is more slippery under the cow's feet.

While superphosphate added on the loaded manure spreader will distribute the phosphate evenly on hayland, it lacks the advantage of conserving ammonia because it doesn't come in contact with the freshly voided urine which readily ammonifies and from which ammonia so readily escapes. Recent experiments have well proven the merit of phosphated manure on hayland.

Muriate of potash on the top of the loaded manure spreader is another way to improve permanent hay. There are a number of soils, especially sands and loams, in this region that need extra potash in addition to manure to produce good hay. Experiments indicate that the potash has no beneficial or detrimental effect upon the nitrogenous part of manure, but since the manure is moist it absorbs and holds the potash. In this way potash is protected against excessive fixation because only part of the potash becomes intimately mixed with the soil. This is especially true on some soils that are known to fix rather large amounts of potash. There is no harm in using potash in barn gutters provided the liquid manure is carefully conserved, but perhaps the most practical way is to use it on top of the loaded spreader. It has been found just as effective on the spreader where the manure has previously been phosphated.

Means of Liming

Hydrated or burned agricultural lime spread evenly in the clean gutter (two pounds per cow per day) is a means of liming hayland. It also preserves some nitrogen which would otherwise escape into the air as ammonia, (Vt. Sta. Bul. 456). Its beneficial action depends on making the urine so alkaline that ammonifying bacteria and enzymes are prevented from converting urea to ammonia. Hydrated lime eventually carbonates and finally loses its main preservative action. The length of time depends upon the temperature—the cooler the longer the period of active preservation. The manure should be applied to the land before the lime completely carbonates if nitrogen is to be preserved for plants in this fashion.

Probably such use of caustic lime with manure seems contrary to all established rules and teachings to the effect that lime on manure would drive off valuable ammonia. It is recognized that if ammonia is present, caustic lime will drive it off. Nevertheless, all good rules have exceptions, and a valuable one now discovered is, in brief: Caustic lime used in the clean gutter can not drive off ammonia because it is present before ammonia is formed, and because its strong alkalinity blocks ammonia formation.

Most of the urine naturally goes to the bottom of the gutter where it comes

in direct contact with the very alkaline lime, but the urine not in contact with the lime begins to ammonify. When the manure is shoveled from the gutter, the limed bottom portion becomes partly mixed with the upper part and some ammonia is immediately released. However, in spite of this slight immediate loss, the treated manure ultimately loses less nitrogen (from subsequent drying or freezing) when it is spread on the land. Barn trials conducted bear out this statement.

For the improvement of hayland it is recommended that caustic lime and superphosphate be used in the gutter one at a time, otherwise their chemical actions would nullify each other. When the yearly allowance of superphosphate is thus used up, change to caustic lime. One can thus separately phosphate and lime his land by way of the gutter.

Ground limestone seems to have no beneficial or detrimental effect on manure because both are about the same degree of alkalinity. Farmers who do not have lime spreaders may add ground limestone (not caustic lime) on top of the loaded manure spreader and thus spread it this way. Ground limestone may also be applied in this way on phosphated manure with no detrimental effect either to the availability of the phosphate or the manurial nitrogen. This, therefore, permits two effective ways in which lime for permanent hay can be applied by way of the manure spreader.

The prime objective in maintaining permanent hay is an abundance of well-balanced plant food. This can be attained either with complete fertilizers and lime, or with manure improved with superphosphate, potash and lime. Furthermore, such permanent hay improved the plant-food way is a better food for animals by reason of the extra minerals it contains and thereby is indirectly a guarantee of better human nutrition.

Secrets Galore

(*From page* 5)

loggerheads like the food faddists and vitamin dopesters, because some think one way and some another and nobody has really found the whole truth or got it trade-marked yet.

Rare elements not yet fully recognized as contributing to the welfare of agricultural plants are bound to come into the picture sooner or later. It means new ways of farming a hundred years hence, and maybe fewer farmers to work the land besides. Nothing shows the "utter unknown" horizons in agriculture to a greater degree than trying to match your wits with wilted crops and wasted soils.

That's why Jonathan was correct when he said that there are more secrets lying loose out in his old eighty than anything we *don't* get to read in the war bulletins. And if he lays himself out this spring to unlock some of that fertility when it's most useful on that old farm, he's going to be as patriotic as the President and busier than five Japs fighting one American.

But the farmer's stock of mystery stories about plant life is not ended with providing satisfactory environment below ground level for his crops. Myriads of pests threaten the security of agricultural plants as soon as they peer into the sunlight. At this point he begins a defensive as well as a continuous offensive struggle extending from germination test to harvest. Each season seems to bring forth some new and alarming insect or disease germ to give the lie to the old wheeze, "There's nothing new under the sun."

In case the producer still feels he is working in a sphere of comparative placidity and humdrum routine, the weather breaks into his pipe dream

with dust storms and floods, tornadoes and early frosts, withering droughts and backward springs—each and every change kept strictly secret, both by Dame Nature herself and now by federal manifesto to boot!

But let's presume all the plant secrets work with him and the mystery story of his crop turns out well, may the farmer then heave his grain and alfalfa into the contented kine and say to himself, "Here at last I face a certainty, for I bought me a fine bull at a consignment sale, one with a fancy pedigree and a good top line and guaranteed to be a sure breeder!"

Why, that too is just as big a myth as the defense of Singapore and not any too reliable to bank on. In order to make doubly sure that the bull is worth his salt and silage you'll have to prove him up, Friend Farmer, using a series of dam-and-daughter production comparisons so as to obtain his real index as a go-getter of something better. Until that is done and the bull is either crowned with laurel in the Holstein hall of fame or cast into the outer darkness of the slaughter pen, you'll have a secret on your hands—and one with horns on it, too.

NOW suppose he proceeds according to plan, proves his bovine Lothario, and gets some promising heifers thereby. Sure, by this time all his secrets are an open book and there's not a thing left for Sherlock Holmes. You wouldn't think so a few months later when you notice how his yard is infested with vets and inspectors inquiring into the why and wherefore of a mess of mastitis he has caught; or maybe a wave of abortion comes along and he loses half of his profits in a fortnight.

To date nobody has a sure cure for garget or abortion, and they both remain among the unpredictables on the farm front. I suppose the same may be said for sundry maladies and miseries affecting the other species of domestic Herbivora whose welfare spells the final successful utilization of the plants the farmer produces in a welter of secrecy, mystery, and uncertainty.

However, we may finally surmise that long and constant association with these familiar secrets entitles us to survey the world with calm and unbroken confidence insofar as agriculture's duty and responsibility go.

That is, we may think that the above list of unknown hazards is not worth worrying over; that America is perfectly self-sustained and capable of coping with prolonged strife without bothering much over the reserve supply of goods derived from agricultural plants. But we're wrong again, because the latest restrictions, priorities, and scarcities bring us sharp against the critical realization that we do not live to ourselves alone. We're going to be concerned as never before with the success of tropical farming below the Gulf of Mexico. And if that isn't a mystery to most of us then I'm an opera singer!

MYSTERY used to be thrown around some of our common farm crops by Latinizing them into Zea mays, Trifolium repens, and Medicago sativa; and when we translated these in terms of bumper ears and tonnages of legumes it sounded sort of fancy and romantic.

But few of us would recognize on sight two of the strategic plants of the present crisis, Cinchona and Hevea, nor would we have given them much thought a few months ago. Neither represent anything we can rush right into and get excited about cultivating, but they both widen our professional outlook into the realm of the necessary unknown. We can't afford to postpone aid to the brethren of the South American plantations whose privilege and opportunity it is to grow quinine and rubber for us. For once, their worries are our worries, their pests are our pests, and we welcome such imports instead of abusing them.

Taken together with coffee, tea, spices, and some other tropical products, it looks as though such noncompeting crops would loom in far

greater significance in our balance of trade than before the war. Maybe they will assume such importance to our economy and necessity that our Midwest farmers will stop squawking about Argentine corn and Brazilian beef long enough to get the right perspective.

WE WERE so wild-eyed waving the Monroe Doctrine around the hemisphere during the past 40 years that we overlooked the little secret that one or two good ideas might be let in with good results, even if some other things were kept out. While we were guarding the western neighborhood, we also let some things out that should have been kept in, which include further experiments with quinine "fever trees" and rubber plants. We let a lot of precious cultural secrets go into the Pacific Archipelago when we did that. That's why we have a courageous corps of plant specialists and botanical scouts delving in the jungles of Central and South America, trying to detect the secrets, long lost to western mankind, relative to the culture of these two critical crops.

Exacting requirements of climate and soil are necessary to raise quinine successfully. Seedlings are very delicate and need artificial protection, altitudes make great differences in the degree of bark growth, and the soil must have just the right blend of sand and clay. All these facts must be discovered all over again down in Guatemala and Colombia, where much of this pioneering is going on. Only glimmerings of meager records are available from the times prior to the civil war when the original commercial culture of Cinchona started, fostered by the legendary cure made by use of quinine on the Countess of Chinchon by the court physician, Dr. Juan de Vega, in the seventeenth century.

But at least ten years must elapse before the laudable but late attempts now under way are successful in assuring the Western Hemisphere of a sufficient home-produced quantity of fever-and-ague dosage.

No less "feverish" efforts are being made to develop the Hevea rubber tree to meet the tremendous demand in this country which we realized only when the trade routes to the Orient were shut in our faces. According to recent reports, more small individual plantation systems for growing rubber are to be encouraged in South America, instead of putting emphasis on huge estate production. Crude rubber of top quality can be produced on small acreages with makeshift equipment costing not over fifty dollars, and by making double use of the land with intertilled crops growing between the rubber rows, the small farmer can compete with the "hacienda" or wealthy rancher. Besides trying to encourage small scale enterprise, there is a veritable land army of scientists studying the problem at the Brazilian experiment farms. Latin America already has a small output of crude rubber from wild trees, and they say the jungles are full of millions of untapped trees which might supply the temporary demand until the plantation tracts are all set for business.

SINCE the hullabaloo about secret cartels between domestic and foreign corporations was brought to light, folks are less inclined to boost the synthetic rubber proposition and tend to put most of their dependence upon the final solution of the campaign to grow and manufacture the real article. They are willing to wait for patient plant doctors to unravel growth secrets, but they have no time or relish for the tricksters who dabble in international secrets to retard the general welfare.

But as our farmers return to the land again in preparation for a bumper yield, we repeat the old truth, which is, that despite grave uncertainty and secrets galore ahead of them, the tillers will carry on with customary faith—"substance of things hoped for and the evidence of things not seen"—and finish the season with relative satisfaction. This fact, plus a dearth of labor, makes their contribution unique among the patriots of the world.

MISQUOTED

Emperor of Japan: "When we win this war I'm going to rule the world."

Mussolini: "No, you're not—I am, because the Lord said, 'The meek shall inherit the earth.'"

Hitler: "That's a lie—I never said any such thing!"

The three bears were taking a walk on the desert, so Goldilocks could eat the little bear's porridge.

Papa Bear sat on a cactus and said "Ouch!"

Mama Bear sat on a cactus and said "Ouch!"

The little bear sat on a cactus and didn't say anything—just sat.

Mama Bear turned to Papa Bear. "Paw," she said, "I hope we're not raising one of those Dead End Kids."

She: "My husband is always away on business trips. What would you do in my place?"

He: "Well, take me over to your place and I'll show you."

A henpecked looking little man was escorting his wife to a concert and arrived late. Slipping into his seat, he turned to his neighbor.

"What are they playing?" he whispered.

"The Fifth Symphony," came the low answer.

"Well," muttered the little man, "Thank God, I've missed four of 'em, anyway."

The visitor joined his companions on the first tee. He took his stance, waggled his club, took a tremendous swing and missed the ball completely.

"Be gad," he said to his opponents, "It's a good thing I found out early in the game that this course is at least three inches lower than the one I usually play."

There was a young lady from Kent
Who said that she knew what it meant,
When men asked her to dine,
Gave her cocktails and wine,
She knew what it meant—but she went.

Two salesmen met in a Pullman after not seeing each other for three years. "Jim," said one of them, "the defense program is speeding everything up but you still talk just as slow as ever."

"Well," said Jim, "if—you—think—I talk—slow—you—should—hear—my secretary. She — had — a date — the — other — night — and — her — boy — parked—on the—way—home. And—before — she — could — say — I'm — not — that — kind — of — a — girl, — she was."

Judge: "This man says that after he fired a shot he saw you run from his chicken coop."

Rastus Johnsing: "He could easy be mistaken, Jedge, fast ez Ah was runnin', it mought have been someone else what faintly resembles me."

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FERTILIZER *Films* AVAILABLE

WE shall be pleased to loan to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, responsible farm organizations and members of the fertilizer trade, films bearing on the proper use of fertilizers, particularly potash. Anyone interested in showing these films should direct his requests to our Washington office.

Potash Production in America

Shows the location and formation of American deposits and scenes of mining and refining of potash in California and New Mexico.

16 mm.—silent, color—running time 40 min. (on 400 ft. reels).

Potash in Southern Agriculture

Covers fertilization and potash deficiency symptoms of cotton, tobacco, and corn at several Experiment Stations in the South, also crops in the field, fertilizer placement work, and scenes in a fertilizer factory.

16 mm.—sound, color—running time 20 min. (on 800 ft. reel).

Bringing Citrus Quality to Market

Shows influence of fertilizers, particularly potash, on yield, thickness of rind, volume of juice, weight, and general appearance of citrus fruit.

16 mm.—silent, color—running time 25 min. (on 800 ft. reel).

New Soils From Old

Experimental work on Illinois Soil Experiment Fields and the benefits from a balanced soil fertility program using limestone, phosphates, and potash in growing corn, wheat, clover, and other crops.

16 mm.—silent, color—800 ft. edition running time 25 min.; 1,200 ft. edition running time 45 min. (on 400 ft. reels).

In The Clover

Depicts the value, uses, and fertilizer requirements of Ladino clover in Northeastern agriculture.

16 mm.—silent, color—running time 45 min. (on 400 ft. reels).

Ladino Clover Pastures

Determining proper fertilization of Ladino Clover for best utilization as pasture for livestock and poultry in California.

16 mm.—silent, color—running time 25 min. (on 400 ft. reels).

Potash Deficiency in Grapes and Prunes

Effects of potash deficiency and fertilizer treatments on grapes and prunes in California.

16 mm.—silent, color—running time 20 min. (on 400 ft. reel).

Machine Placement of Fertilizer

Methods of applying fertilizer to California orchards, lettuce, and sugar beets with various types of apparatus devised by growers.

16 mm.—silent, color—running time 20 min. (on 400 ft. reel).

Potash From Soil to Plant

Sampling and testing soils by Neubauer method to determine fertilizer needs and effects of potash on Ladino clover in California.

16 mm.—silent, color—running time 20 min. (on 400 ft. reel).

Requests for these films *well in advance* should include information as to group before which they are to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

AMERICAN POTASH INSTITUTE, INC.

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